MAR ATHANASIUS COLLEGE (AUTONOMOUS) KOTHAMANGALAM, KERALA – 686666

College with Potential for Excellence

NAAC Accredited 'A^{+}' Grade Institution

Email: mac@macollege.inwww.macollege.in

REGULATION, SCHEME AND SYLLABUS

FOR

UNDERGRADUATE PROGRAMME

UNDER CHOICE BASED CREDIT SYSTEM

(MAC- UG-CBCS 2021)

B.Sc CHEMISTRY

MACUGSCHE1002

EFFECTIVE FROM THE ACADEMIC YEAR 2021-22

BOARD OF STUDIES IN CHEMISTRY (UG)

ACADEMIC COUNCIL

COMPOSITION – With Effect from 01-06-2020

Chairperson : **Dr. Shanti. A.Avirah**
Principal
Mar Athanasius College (Autonomous)
Kothamangalam

Experts/Academicians from outside the College representing such areas as Industry, Commerce, Law, Education, Medicine, Engineering, Sciences etc.

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   Secretary

   Mar Athanasius College Association Kothamangalam

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4. **Dr. SheelaRamachandran**

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   Senior Professor and Dean,

   Indian Institute of Space Science and Technology (IIST),

   Department of Space, Govt. of India, Valiyamala, Thiruvananthapuarm

6. **Dr. M.C. DileepKumar**

   Former Vice Chancellor

   SreeSankaracharya Sanskrit University Kalady, Kerala, India

7. **Dr. Mathew.K.**

   Principal

   Mar Athanasius College of Engineering

   Kothamangalam, Kerala - 686 666

8. **Adv. George Jacob**

   Senior Advocate High Court of Kerala

Nominees of the University not less than Professors

9. **Dr. BijuPushpan**

   SAS SNDP Yogam College Konni

10. **Dr. Suma MarySacharia**

    UC College Aluva

11. **Dr. V.B.Nishi**

    Associate Professor

    SreeShankara College, Kalady.

Member Secretary

12. **Dr.M.S.Vijayakumary**

    Dean – Academics

    Mar Athanasius College (Autonomous) Kothamangalam

Four teachers of the college representing different categories of teaching staff by rotation on the basis ofseniority of service in the college.

13. **Dr. Bino Sebastian. V** (Controller ofExaminations)
14. **Dr. Manju Kurian,** Asst. Professor, Department ofChemistry
15. **Dr. Smitha Thankachan**, Asst. Professor, Department ofPhysics
16. **Dr. Asha Mathai**, Asst. Professor, Department ofMalayalam

Heads of the Departments

17. Dr. Densely Jose, Head, Department of Chemistry

18. Dr. Mini Varghese, Head, Department of Hindi

19. Ms. Shiny John, Head, Department of ComputerScience

20. Dr. Igy George, Head, Department ofEconomics

21. Dr. Rajesh.K. Thumbakara, Head, Department ofMathematics

22. Dr. Aji Abraham, Head, Department of Botany

23. Dr. Selven S., Head, Department of Zoology

24. Dr. Deepa. S, Head, Department of Physics

25. Dr. Aswathy Balachandran, Head, Department of English

26. Dr. Diana Ann Issac, Head, Department of Commerce

27. Ms. Seena John, Head, Department of Malayalam

28. Ms. Diana Mathews, Head, Department of Sociology

29. Ms. Sudha. V, Head, Department of Statistics

30. Dr. Jani Chungath, Head, Department of History

31. Sri. Haary Benny Chettiamkudiyil, Head, Department of Physical Education

32. Ms. Shari Sadasivan, Head, Department of Marketing and International Business

33. Dr. Julie Jacob, Head, Department of Biochemistry

34. Ms. Nivya Mariyam Paul, Head, Department of Microbiology

35. Ms. Jaya Vinny Eappen, Head, Department of Biotechnology

36. Ms. Shalini Binu, Head, Department of Actuarial Science

37. Ms. Simi. C.V, Head, Post Graduate Department of History

38. Ms. Sari Thomas, Head, Post Graduate Department of Statistics

39. Ms. Sheeba Stephen, Head, Department of B.Com Model III

40. Ms. Dilmol Varghese , Head, Post Graduate Department of Zoology

41. Ms. Bibin Paul, Head, Post Graduate Department of Sociology

BOARD OF STUDIES IN CHEMISTRY

MAR ATHANASIUS COLLEGE, (AUTONOMOUS) KOTHAMANGALAM Members of the Board of Studies - UG Programme Subject: CHEMISTRY	
NAME	DETAILS
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Dr. DENSELY JOSE	HOD and Associate Professor in Chemistry, M.A College, Kothamangalam
EXPERTS(2)	
DR.S. SUGUNAN	Emeritus Professor in Applied Chemistry, CUSAT, Kochi
DR. PAULSON MATHEW	Associate Professor in Chemistry St. Thomas College Thrissur.
ONE EXPERT - TO BE NOMINATED BY V C (MGU)	
DR.K.L. SEBASTIAN	Professor Dean, Department of Physical Chemistry, IIT, Palakkad.
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DR. KOCHUBABY MANJOORAN	Dy. Manager (Energy & Environment) BPCL, Kochi Refinery
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FACULTY MEMBERS OF THE DEPARTMENT WITH Ph.D	
Dr SHANTI. A. AVIRAH	Associate Professor in Chemistry M.A College Kothamangalam
Dr. MANJU KURIAN	Assistant Professor in Chemistry M.A. College, Kothamangalam
Dr. ANNU ANNA VARGHESE	Assistant Professor in Chemistry M.A. College, Kothamangalam
Dr. BINU VARGHESE	Assistant Professor in Chemistry M.A. College, Kothamangalam
Dr. MARYMOL MOOTHEDAN	Assistant Professor in Chemistry M.A. College, Kothamangalam

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PREFACE

Chemistry is a wide-ranging science concerned with matter at the atomic and molecular scale. Important facets are synthesis, structure, microscopic mechanisms, properties, analysis and transformations of all types of materials. Chemists are a constant source of innovation: it is hard to imagine any product introduced in recent times that did not require the creative efforts of a chemist. Chemistry underpins the conceptual framework and methodology of biochemistry and molecular medicine and is at the heart of many major industries.

Mar Athanasius College, Kothamangalam, in its pursuit of academic excellence was accorded Autonomous status in March 2016. In order to cope with the internationally followed curricula and mode of evaluation, the department was directed to revise the curriculum and syllabi of postgraduate course. The guidelines are provided by the college.

This curriculum is prepared to give sound knowledge and understanding of chemistry to undergraduate students. Salient features of the present syllabus are

1) It provides logical sequencing of the units of the subject matter with proper placement of concepts with their linkages for better understanding.

2) Emphasis has been on promoting processing skills, problem solving abilities, training in laboratory skills and instrumentation, nurturing curiosity and applications of concepts of chemistry useful in real life situations, making learning of chemistry more relevant and interesting.

3) Inculcate the value of honesty, integrity, co-operation, concern for life and preservation of the environment.

4) Equip the students to face challenges related to health, nutrition, environment, population, weather, industries and agriculture.

This syllabi is prepared in a participatory manner, after discussions with a number of teachers in the subject and experts from industries and also comparing with the existing syllabi of M. G. University, other Universities and autonomous colleges. The draft syllabus prepared by the members of the faculty was discussed in detail in meetings of Board of the Studies held on 17-12-2016, 28-2-2017, 26-8-2017, 9-11-2017, 1-12-2018

and 17-10-2019 respectively. Appreciable updating has done in keeping with current developments and trends in Chemistry.

I would like to express my sincere gratitude to all the members of the Board of Studies, especially, Dr.K.L.Sebastian, Professor Dean, IIT Palakkad, Dr.S.Sugunan, Emeritus Professor, Dept. of Applied Chemistry, CUSAT and Dr. Paulson Mathew, Associate Professor, Dept. of Chemistry, St. Thomas College, Thrissur for their whole hearted time bound help, cooperation and encouragement. I also thank Dr.Annu Anna Varghese, Assistant professor in Chemistry, M.A College Kothamangalam for coordinating and editing the Under Graduate syllabus in Chemistry.

Chairperson and Members
Board of Studies of Chemistry (UG)
Mar Athanasius College (Autonomous),
Kothamangalam

MAR ATHANASIUS COLLEGE (AUTONOMOUS)

KOTHAMANGALAM, KERALA – 686666

REGULATIONS OF THE UNDERGRADUATE PROGRAMMES

UNDER CHOICE BASED CREDIT SYSTEM

(MAC- UG-CBCS 2021)

(2021 Admission onwards)

PREAMBLE

Education prepares a man to live with dignity and liberty. The ultimate aim of education is to deepen man's understanding of the universe and of himself-in body, mind and spirit –and to disseminate this understanding throughout society and to apply it in the service of mankind. This aim is accomplished when quality is ensured in the process of learning. Ever since Independence there have been several attempts on the part of Central and State Governments, University Grants Commission, AICTE and similar regulatory bodies as well as universities and colleges to improve the quality of instruction offered. However, because of heavy demand for access and consequent expansion of colleges and universities together with constraints on resources, standards of education could not cope with expansion. The affiliating system, which played a useful role in managing access in the past, occupied disproportionate time on administration of the system and undermined the capacities of universities and colleges to work towards research and development. Even curricular reform took a back seat in many universities. While there is no alternative in the present context to the system of affiliation, there is a felt need to seek fresh strategies for innovation and experimentation in the entire range of higher education activities at the institutional level. In this scenario, the Government of India by Resolution dated 14 July 1964 appointed the Education Commission to advise the Government on the national pattern of education and policies for the development of education at all stages and in all aspects. The Education Commission (1964 – 66) recommended "Autonomy" to Universities and colleges as instrumental in achieving and promoting academic excellence in higher education (Chapter XIII). In consonance with this recommendation, the University Grants Commission prepared Guidelines for Autonomy (Annexure II) during XIth plan and the same has been revised subsequently during XIIth plan. In the context of UGC Guidelines, the Committee set up by the Kerala

State Higher Education Council in December 2012 to recommend criteria for selection and steps for operationalization of "Autonomous Colleges" in Kerala, deliberated on the subject extensively. Accordingly, the 13th Kerala State Legislative Assembly as per the "the University Laws (Third Amendment) Bill, 2014 resolved to provide Autonomy to colleges and Universities in Kerala. Mar Athanasius College, Kothamangalam, in its pursuit of academic excellence, was accorded Autonomous Status as per the Letter No. F.22 – 1/2016 (AC), dated 9th March, 2016. Following the attainment of autonomous status, the expert committee constituted by the Principal has undertaken the task of designing a draft Regulations and Guidelines of all Undergraduate Programmes in the institution in 2016. During the academic year 2016-17(For the 2016 admission) the then prevailing M. G. University regulations were accepted by the institution without any change. In the academic year 2017 the institution prepared UG regulations after making necessary modifications. The total credit, internal assessment, evaluation of answer sheets, Question paper pattern and conduct of examination were strictly adhered to the parent university regulations. The modified regulation came into force in academic year 2018(with effect 2018 admission onwards) and the same regulation continued until 2020-21. In due course as per the recommendations of the academic council held on 19.06.2020, the 2018 UG regulations has been hitherto, modified by incorporating the modifications put forward by M.G. University as per U.O No. 1417/AC A9/2020 MGU Dated10.03.2020. The framework of the Common Guidelines and regulations are presented in the ensuing pages.

1. TITLE

1.1. These regulations shall be called **"REGULATIONS FOR UNDERGRADUATE (UG) PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM, 2021 (MAC- UG-CBCS 21)"** of Mar Athanasius College (Autonomous), Kothamangalam.

2. SCOPE

2.1 Applicable to all Undergraduate Programmes conducted by Mar Athanasius College (Autonomous), Kothamangalam with effect from 2021-22 admissions.

2.2 Medium of instruction is English except in the case of language courses other than English unless otherwise stated therein.

3. DEFINITIONS

3.1. ***'Academic Week'*** is a unit of five working days in which distribution of work is organized from Day One to Day Five, with five contact hours of one hour duration on each day.

3.2 '***Semester'*** means a term consisting of a minimum of 90 working days, inclusive of tutorials, examination days and other academic activities, within a period of six months.

3.3 ***'Programme'*** means a three year programme of study with examinations spread over six semesters. The successful completion of the programme leads to the award of a Bachelor Degree.

3.4 ***'Course'*** means a portion of a subject, which will be taught and evaluated in a semester (similar to a paper under Annual scheme). Each Course is to be designed under lectures / tutorials / laboratory / fieldwork / seminar/ project / practical training / assignments and evaluation etc., to meet effective teaching and learning needs.

3.5. ***'Common Course I'*** means a course that comes under the category of courses for English.

3.6 ***'Common Course II'*** means additional language (Malayalam or Hindi).

3.7. ***'Core Course'*** means a course in the subject of specialization within an Under Graduate Programme.It includes a course on environmental studies and human rights.

3.8. ***'Complementary Course'*** means a course which would enrich the study of core courses.

3.9. ***'Choice Based Course'*** means a course that enables the students to familiarise the advanced areas of Core Course.

3.10. ***'Open course'*** means an optional course which the student is free to take at his/her will. Open Course shall be a non-major elective course offered by the Departments other than parent Department.

3.11 '***Certificate Course / Diploma Course'*** means courses that permit an opportunity to the students for academic enrichment in an area other than the traditional programmes to which he/she is admitted. Such courses will lead the candidate toward entry level employment in a professional field. The duration and general frame of the courses are subject to the regulations prescribed by the UGC from time to time. Certificate/Diploma courses shall be conducted over and above regular working hours.

3.12. *'**Credit'*** is the numerical value assigned to a course according to the relative importance of the syllabus of the programme**.**

3.13. ***'Grade'*** means a letter symbol (e.g: A, B, C, etc.) that indicates the broad level of performance of a student in a course/ semester/programme.

3.14. ***'Grade Point' (GP)***is the numerical indicator of the percentage of marks awarded to a student in a course.

3.15. **Institutional Average (IA)** means average marks secured (Internal + External) for a course at the college level

3.16. ***'Credit Point (CP)'***of a course is the value obtained by multiplying the Grade Point (GP) by the Credit (C) of the course. CP=GP x C.

3.17. ***'Cumulative Credit Point Average (CCPA)'*** is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits.

3.18. ***'Department'*** means any Teaching Department in the College.

3.19. '***Parent Department'*** means the department which offers core courses within an Under Graduate Programme.

3.20. ***'Department Council'*** means the body of all teachers of a department in the college.

3.21. *'**Department Co-ordinator'*** means a teacher from the parent department nominated by the Department Council, who will advise the student in the academic matters.

3.22. ***'College Coordinator'*** is a teacher nominated by the Principal to co-ordinate the continuous evaluation undertaken by various departments within the college.

3.23. '***Grace Marks'*** means marks awarded to the candidates as per the orders issued by Mahatma Gandhi University, Kottayam, from time to time.

3.24. ***'Skill Enhancement Programme'*** means Programme intended to assist the students to acquire additional practical skills which should be conducted over and above the regular working hours.

3.24. Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes of the Mahatma Gandhi University.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

4.1 Eligibility and Norms for admission and reservation of seats for various Undergraduate Programmes shall be according to the rules framed by the Mahatma Gandhi University/State Government from time to time.

5. DURATION

5.1 The duration of UG programmes shall be ***6 semesters***.

5.2 There shall be two semesters in an academic year. The **ODD** semester commences in **June** and on completion, the **EVEN** semester commences. There shall be two months' vacation during April and May in every academic year.

5.3 A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.

6. REGISTRATION

6.1 The strength of students for each course shall remain as per existing regulations as approved by Mahatma Gandhi University, Kottayam.

6.2 The college shall send a list of students registered for each programme in each semester giving the details of courses registered to the University in the prescribed form within 45 days from the commencement of the Semester.

6.3 Those students who possess the required minimum attendance and progress during a semester and could not register for the semester examination are permitted to apply for Notional Registration to the examinations concerned, enabling them to get promoted to the next class.

7. SCHEME AND SYLLABI

7.1. The UG programmes shall include (a) Common courses I and II, (b) Core courses, (c) Complementary Courses, (d) Choice Based Course and(e) Open Course. Common course II is exempted in the case of B.Com Model III.

7.2. There shall be one Choice Based course (Elective Course) in the sixth semester. In the case of B.Com Programme there shall be an elective stream from third semester onwards.

7.3 Credit Transfer and Accumulation System can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one College to continue their education in another College without break. Credit transfer shall be permitted as per the University Rules.

7.4. A separate minimum of 30% marks each for internal and external (for both theory and practical) and an aggregate minimum of 35% are required to pass a course. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme only **F Grade will be awarded** for that Semester/Programme until he/she improves this to **D Grade** or above within the permitted period.

7.5. Students who complete the programme with "D" Grade under **"REGULATIONS FOR UNDERGRADUATE (UG) PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM, 2021 – MAC – UG- -CBCS 2021"** of Mar Athanasius College (Autonomous), Kothamangalam will have

one betterment chance within 12 months, immediately after the publication of the result of the whole programme.

7.6 The UG Board of Studies concerned shall design all the courses offered in the UG programme. The Boards shall design new courses and modify or re-design existing courses to facilitate better exposure and training for the students.

7.7. The syllabus of a course shall include the title of the course, contact hours, the number of credits and reference materials.

7.8. Students discontinued from previous regulations CBCS 2018 of Mar Athanasius College (Autonomous), Kothamangalam can pursue their studies in the Mar Athanasius College (Autonomous) Kothamangalam under "Regulations for Under Graduate Programmes under Choice Based Credit System 2021"after obtaining readmission. These students have to complete the programme as per the Mar Athanasius College (Autonomous)"Regulations for Under Graduate Programmes under Choice Based Credit System 2021 (MAC – UG – CBCS 2021)".

7.9. The practical examinations (external/internal) will be conducted only at the end of even semesters for all programmes. Special sanction shall be given for those programmes which are in need of conducting practical examinations at the end of odd semesters

8. PROGRAMME STRUCTURE

The structure of UG Programmes is as follows

Model I B.A/B.Sc.

A	Programme Duration	6 Semesters
B	Total Credits required for successful completion of the programme	120
C	Credits required from **common course I**	22
D	Credits required from **common course II**	16
E	Credits required from Core Course and Complementary Course including Project	79
F	Credits required from Open course	3
G	Minimum attendance required	75%

Model I B Com

A	Programme Duration	6 Semesters
B	Total Credits required for successful completion of the programme	120
C	Credits required from **common course I**	14
D	Credits required from **common course II**	8
E	Credits required from Core Course and Complementary Course	95
F	Credits required from Open course	3
G	Minimum attendance required	75%

Model III B Com

A	Programme Duration	6 semesters
B	Total Credits required for successful completion of the programme	120
C	Credits required from **Common Course I**	8
D	Credits required from Core + Complementary + Vocational courses including Project	109
E	Credits required from Open Course	3
G	Minimum attendance required	75%

9. EXAMINATIONS

9.1 The evaluation of each course shall contain two parts:

(i) Internal or In-Semester Assessment (ISA)

(ii) External or End-Semester Assessment (ESA)

The in-semester to end semester assessment ratio shall be 1:4.

Both Internal and External marks are to be rounded to the next integer.

9.2 For all courses (theory & practical), grades are given on a **10- point scale,** based on the total percentage of marks ***(ISA+ESA)*** as given below:

Percentage of Marks	Grade	Grade Point (GP)
95 and above	S Outstanding	10
85 to below 95	A+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B+ Good	7
55 to below 65	B Above average	6
45 to below 55	C Satisfactory	5
35 to below 45	D Pass	4
Below 35	F Failure	0
	Ab Absent	0

10. CREDIT POINT(CP)AND CREDIT POINT AVERAGE (CPA)

1. Credit Point (CP)

Credit Point (CP) of a paper is calculated using the following formula.

$$CP = C \times GP$$

Where:

C is the Credit and

GP is the Grade point

2. Credit Point Average (CPA)

Credit Point Average (CPA) of a Course (Common Course I, Common Course II, Complementary Course I, Complementary Course II, and Core Course) is calculated using the following formula.

$$CPA = TCP/TC$$

Where:

TCPis the Total Credit Point of course and

TC is the Total Credit of that category of course

3. Semester Credit Point Average (SCPA)

The Semester Credit Point Average (SCPA) of a Semester is calculated using the following formula.

$$SCPA = TCP/TC$$

Where:

TCP is the Total Credit Point of that semester and

TC is the Total Credit of that semester

4. Cumulative Credit Point Average (CCPA)

Cumulative Credit Point Average (CCPA) is calculated using the following formula.

$$CCPA = TCP/TC$$

Where;

TCP is the Total Credit Point of that Programme and

TC is the Total Credit of that programme

Grades for the different semesters and overall programme are given based on the corresponding CPA as shown below:

CPA	Grade
9.5 and above	S Outstanding

8.5 to below 9.5	A^+ Excellent
7.5 to below 8.5	A Very Good
6.5 to below 7.5	B^+ Good
5.5 to below 6.5	B Above average
4.5 to below 5.5	C Satisfactory
4to below 4.5	D Pass
Below 4	F Failure

11. MARK DISTRIBUTION FOR EXTERNAL AND INTERNAL EVALUATION

The end semester examinations of all semesters shall be conducted by the college at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses without practicals, total marks of external examination is 80 and total marks of internal evaluation is 20. Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

11.1 FOR ALL COURSES WITHOUT PRACTICAL

a) Marks of External Examination : 80

b) Marks of Internal Evaluation : 20

All the four components of the internal assessment are mandatory.

Components of Internal Evaluation of theory	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**5**
Test papers (2x5)	**10**
Total	**20**

11.2 FOR ALL COURSES WITH PRACTICAL

a) Marks of External Examination :60

b) Marks of Internal Evaluation : 15

11.2.1 FOR THEORY

Components of In-Semester Evaluation of Theory	Marks
Attendance	**5**
Assignment /Seminar/Viva	**2**
Test papers (2x4)	**8**
Total	**15**

11.2.2 FOR PRACTICAL EXAMINATION

a) External 40

b) Internal 10

Components of In-Semester Evaluation of Practical	Marks
Attendance	2
Test papers (1x4)	4
Record*	4
Total	**10**

*Marks awarded for Record should be related to the number of experiments recorded and duly signed by the teacher concerned in charge.

All three components of internal assessments are Mandatory.

11.3 PROJECT EVALUATION: (Maximum Marks 100)

All students are to do a project in the area of the core course. This project can be done individually or in groups (not more than five students) for all subjects which may be carried out in or outside the campus. Special sanction shall be obtained from the Principal to those new generation programmes and programmes on performing arts where students have to take projects which involve larger groups. The projects are to be identified during the II semester of

the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and is to be produced before the examiners (Internal and External) appointed by the Controller of Examinations. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme.

For Projects

a) Marks of External Evaluation :80

b) Marks of Internal Evaluation : 20

Components of External Evaluation of Project	**Marks**
Dissertation (**External)**	50
Viva – Voce (**External)**	30
Total	**80**

*Marks for Dissertation may include study tour report if proposed in the syllabus

***Components of Internal Evaluation of Project**	**Marks**
Punctuality	5
Experimentation/Data collection	5
Knowledge	5
Report	5
Total	**20**

11.4 ATTENDANCE EVALUATION FOR ALL COURSES (Theory/Practical)

Percentage of attendance	**Marks**

90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1
Below 75	0

(Decimals are to be rounded to the next higher whole number)

12. ASSIGNMENTS

Assignments are to be done from first to fourth Semesters. At least one assignment should be done in each semester.

13. SEMINAR/VIVA VOCE

A student shall present a seminar in the Fifth semester for each course

and appear for Viva-voce in the sixth semester for each course.

14. INTERNAL ASSESSMENT TEST PAPERS

Two Test papers are to be conducted in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for one year and shall be made available for verification. The responsibility of evaluating the internal assessment is vested on the teacher (s), who teache the course.

14.1 GRIEVANCE REDRESSAL MECHANISM

Internal assessment shall not be used as a tool for personal or other type of vengeance. A student has every right to know how the teacher arrived at the marks. In order to address the grievance of students, a three -level Grievance Redressal Mechanism is

envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: At the level of the concerned Course Teacher

Level2: **Department Level**: The Department cell chaired by the Head of the Department, Faculty Advisor and the Course Teacher concerned as members.

Level 3: **College level**: A committee with the Principal as Chairman, and HOD of concerned Department, Academic Coordinator, and two teachers of the College Grievance Cell as members.

14.2 Academic coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of first semester.

14.3 The in-semester evaluation report in the prescribed format should reach the Controller of Examinations as per the academic calendar.

14.4 The evaluation of all components is to be published in the Department and is to be acknowledged by the candidates. All academic records of in-semester assessments are to be kept in the Department for three years and shall be made available for verification. The responsibility of evaluating the in-semester assessment is vested on the teacher(s), who teach the course.

15. EXTERNAL EXAMINATION

The end semester examination of all Programmes shall be conducted by the College at the end of each semester.

15.1 Students having a minimum of 75% average attendance for all the courses only can register for the examination. A candidate having a shortage of attendance of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme can apply for Condonation in prescribed form on genuine grounds. This Condonation shall not be counted for internal assessment. Condonation of

shortage of attendance, if any, should be obtained at least 7 days before the commencement of the concerned semester examination.

It shall be the discretion of the Principal to consider such applications and condone the shortage on the merit of each case in consultation with the concerned Faculty Advisor and Head of the Department.

Unless the shortage of attendance is condoned, a candidate is not eligible to appear for the examination.

Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also.

Those students who are not eligible to attend the end semester examination due to shortage of attendance, even with Condonation, should take re-admission along with the next batch.

15.2 Those candidates who cannot appear for End Semester Examination or who have failed in the end semester examinations of Fifth and Sixth Semester shall be eligible to appear for supplementary examination by paying separate fees. For reappearance/ improvement, for other semesters the students can appear along with the next batch. Notionally registered candidates can also apply for the said supplementary examinations.

15.3 A student who registers his/her name for the end semester examination will be eligible for promotion to the next semester.

15.4 A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.

15.5 A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registration along with the End Semester examination for the same semester, subsequently. There shall be no improvement for internal evaluation.

15.6 Answer scripts of the external examination shall be made available to the students for scrutiny on request and revaluation/scrutiny of answer scripts shall be done as per the request of the candidate by paying fees.

16. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/she shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

Pattern of Questions for External Examination for Course without Practical

Sl. No.	Pattern	Marks	Choice of questions	Total Marks
1	Short answer/ Problem Type	2	10/12	20
2	Short essay/ Problems	5	6/9	30
3	Essay/Problem	15	2/4	30
Total				80

Pattern of Questions for End Semester Examination for Course with Practical

Sl. No.	Pattern	Marks	Choice of questions	Total Marks
1	Short answer/ Problem Type	1	10/12	10
2	Short essay/ Problems	5	6/9	30

3	**Essay/Problem**	**10**	**2/4**	**20**
Total				**60**

17. RANK CERTIFICATE

The institution publishes a rank list of top 3 candidates for each programme after the publication of 6th semester results. Rank certificate shall be issued to the candidate who secures first position in the rank list. Candidates shall be ranked in the order of merit based on the CCPA scored by them. Grace marks awarded to the students should not be counted fixing the rank/position. Rank certificate shall be signed by the Principal and Controller of Examinations.

18. MARK CUM GRADE CARD

The College under its seal shall issue to the students a MARK CUM GRADE CARD on completion of each semester, which shall contain the following information:

(a) Name of the University
(b) Name of the College
(c) Title & Model of the Under-Graduate Programme
(d) Name of the Semester
(e) Name and Register Number of the student
(f) Code, Title, Credits and Maximum Marks (Internal, External and Total) of each course opted in the semester.
(g) Internal, External and Total Marks awarded, Grade, Grade point and Credit point in each course opted in the semester
(h) Institutional average of the Internal Exam and Average of the External Exam in each course.
(i) The total credits, total marks (Maximum and Awarded) and total credit points in the semester
(j) Semester Credit Point Average (SCPA) and corresponding Grade.
(k) Cumulative Credit Point Average (CCPA), CPA corresponding to Common courses I and II, Core Course, Complementary Course and Open Course.

(m) The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the final semester examination and shall include the final grade(SCPA) scored by the candidate from **1st to 5th** semesters, and the overall grade for the total programme.

19. There shall be 2 level monitoring committees for the successful conduct of the scheme. They are:

1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior most teachers as members.

2. College Level Monitoring Committee (CLMC), comprising Principal, College Council secretary and A.O/Superintendent as members.

20. SKILL ENHANCEMENT PROGRAMME

In addition to the requirement prescribed for the award of Bachelor degree, each student shall participate in the Skill Enhancement Programme (SEP) conducted by each department for a total duration of 40 hours spread over Semester I to Semester VI of all Programmes. SEP is intended to train the students and to inculcate extra skills that enable them to be competent in academic and non-academic matters equally. Separate certificates shall be issued by the institution to the candidate on successful completion of the programme. SEP shall be conducted over and above the regular working hours of each programme.

21. CERTIFICATE/DIPLOMA COURSES: Certificate/Diploma courses such as basics of accounting, animation, photography, garment designing, etc. may be conducted for all Programmes as per the discretion of the Board of Studies of the concerned department. The Board of Studies should prepare the curriculum and Syllabi of Certificate/Diploma courses including contact hours and reference materials. Separate certificates will be issued to the candidate on successful completion of the course. An extra Credit of 2 will be awarded to all the candidates on successful completion of the certificate courses and the same shall be inscribed in the cumulative grade card and the degree certificate of each candidate.

21. A FACTORY VISIT / FIELD WORK/VISIT TO A REPUTED RESEARCH INSTITUTE/ STUDENT INTERACTION WITH RENOWNED ACADEMICIANS may be conducted for all Programmes.

22. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal shall, for a period of one year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any Programme with such modifications as may be necessary from time to time.

Annexure I – Model Mark cum Grade Card

Mar Athanasius College (Autonomous) Kothamangalam

Kothamangalam College P.O. Kothamangalam.

Section :

Student ID :

Date :

MARK CUM GRADE CARD

Name of candidate :

Name of College :

Permanent Register Number (PRN) : Degree :

Name of the Programme :

Name of Examination : First Semester Exam Month &Year

Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Grade awarded (G)	Grade point (GP)	Credit point (CxGP)	Institution Average (IA)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (I)	Maximum	Awarded (E + I)	Maximum					
	Common Course I Common Course II Core Course Complementary Course I Complementary Course II/ Vocational Course Total Total credit points (TCP) Total credit (TC) SCPA: Grade:												

Annexure II Model Mark cum Grade Card (VI Semester)

Mar Athanasius College (Autonomous)

Kothamangalam College P.O.Kothamangalam.

Section :

Student ID :

Date :

MARK CUM GRADE CARD

Name of candidate :

Name of College :

Permanent Register Number (PRN) : Degree:

Name of the Programme :

Name of Examination : Sixth Semester Exam Month &Year

Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Grade awarded (G)	Grade point (GP)	Credit point (CxGP)	Institution Average (IA)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (I)	Maximum	Awarded (E + I)	Maximum					
	Core 9 Core 10 Core 11 Core 12 Choice Based Course Project SCPA Grade												

		Credit	CPA	Grade	Month & Year	Result
	Semester I Semester II Semester III					

	Semester IV Semester V Semester VI					
	Common Course I Common Course II Complementary Course I Complementary Course II Core Course Open Course					
	Overall programme CCPA:					

Annexure III

Reverse side of the Mark cum Grade Card

(COMMON TO ALL SEMESTERS)

Description of the Evaluation Process

Grade and Grade Point

The Evaluation of each Course comprises of Internal and External Components in the ratio 1:4 for all Courses.

Grades and Grade Points are given on a 10-point Scale based on the percentage of Total Marks (Internal + External) as given in Table 1.

(Decimals are to be rounded to the next whole number)

Credit point and Credit point average. Grades for the different Semesters and overall Programme are given based on the corresponding CPA, as shown in Table I.

Table 1

Percentage of Marks	Grade	Grade Point (GP)
95 and above	S Outstanding	10
85 to below 95	A+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B+ Good	7
55 to below 65	B Above average	6
45 to below 55	C Satisfactory	5
35 to below 45	D Pass	4
Below 35	F Failure	0
	Ab Absent	0

Credit point (CP) of a paper is calculated using the formula CP = C x G P, where C is the Credit; GP is the Grade Point.

Credit Point Average (CPA) of a Course/ Semester or Programme (cumulative) etc. iscalculated using the formula CPA =TCP/TC; where TCP is the Total Credit Point; TC is the Total Credit.

For converting SCPA into Percentage, multiply secured SCPA by 10 (SCPA x 10)

For converting CCPA into percentage, multiply secured CCPA by 10 (CCPA x 10)

CPA	GRADE
Equal to 9.5 and above	S Outstanding
Equal to 8.5 and < 9.5	A+ Excellent
Equal to7.5 and < 8.5	A Very Good

Equal to 6.5 and < 7.5	B+ Good
Equal to5.5 and < 6.5	B Above Average
Equal to4.5 and < 5.5	C Satisfactory
Equal to 4 and < 4.5	D Pass
Below 4	F Failure

Note: A separate minimum of **30%** marks each for internal and external (for both theory andpractical) and aggregate minimum of **35%** are required for a pass for a course. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme only **F grade** will be awarded for that Semester/Programme until he/she improves this to **D grade** or above within the permitted period.

ELIGIBILITY FOR ADMISSION

Programme with core subject	Complementary Subject	Eligibility	Number of Seats (Sanctioned)
B.Sc CHEMISTRY (MODEL I)	**MATHEMATICS PHYSICS**	Pass in plus two/equivalent exam with Chemistry as one of the optional subjects	**32**

SCHEME AND STRUCTURE OF B Sc Chemistry PROGRAMME

CONSOLIDATED SCHEME FOR I TO VI SEMESTERS

PROGRAMME STRUCTURE

1. BSC CHEMISTRY PROGRAMME – (MODEL - I)

Sem.	Title with Course code	Course Category	Hours per week	Credits
I	English I	Common	5	4
	English/ Common Course I	Common	4	3
	Second Language I	Common	4	4
	Theoretical and Inorganic Chemistry	Core	2	2
	Volumetric Analysis	Core	2	-
	Complementary Mathematics	Complementary	4	3
	Complementary Physics	Complementary	2	2
	Complementary Physics Practical	Complementary	2	-
II	English II	Common	5	4
	English/ Common Course II	Common	4	3
	Second Language II	Common	4	4
	Theoretical and Analytical Chemistry	Core	2	2
	Volumetric Analysis	Core	2	2
	Complementary Mathematics	Complementary	4	3
	Complementary Physics	Complementary	2	2
	Complementary Physics Practical	Complementary	2	2
III	English III	Common	5	4
	II Lang/Common Course I	Common	5	4
	Organic Chemistry-I	Core	3	3
	Qualitative Organic Analysis	Core	2	-

	Complementary Mathematics	Complementary	5	4
	Complementary Physics	Complementary	3	3
	Complementary Physics Practical	Complementary	2	-
IV	English IV	Common	5	4
	II Lang/ Common Course II	Common	5	4
	Organic Chemistry-II	Core	3	3
	Qualitative Organic Analysis	Core	2	2
	Complementary Mathematics	Complementary	5	4
	Complementary Physics	Complementary	3	3
	Complementary Physical Practical	Complementary	2	2
V	Environmental Studies and Human Rights	Core	4	4
	Organic Chemistry-III	Core	3	3
	Physical Chemistry – I	Core	2	2
	Physical Chemistry – II	Core	2	3
	Open course	Open	4	3
	Qualitative Inorganic Analysis	Core	3	-
	Organic Preparations and Basic Laboratory Techniques	Core	2	-
	Physical Chemistry Practical	Core	3	-
VI	Coordination Chemistry and Organometallics	Core	3	3
	Organic Chemistry-IV	Core	3	3
	Physical Chemistry – III	Core	3	3
	Physical Chemistry - IV	Core	3	3
	Choice Based Course	Core	3	3

	Qualitative Inorganic Analysis	Core	3	2
	Preparation and Basic Laboratory Skills	Core	2	2
	Physical Chemistry Practicals	Core	3	2
	Gravimetric Analysis	Core	2	2
	Project& Viva	Core	-	2

OPEN COURSES: UG18CH5OC

Sl. No.	Semester	Course Code	Course Title
1	V	UG21CH5OC02	Dairy Science
2	V	UG21CH5OC03	Food Science
3	V	UG21CH5OC04	Forensic Science
4	V	UG21CH5OC01	Chemistry in Everyday Life
5	V	UG21CH5OC05	Nanoscience and Nanotechnology

CHOICE BASED COURSES: UG18CH6CB

Sl. No.	Semester	Course Code	Course Title
1	VI	UG21CH6CB07	Nano chemistry and Nanotechnology
2	VI	UG21CH6CB06	Industrial Chemistry
3	VI	UG21CH6CB01	Polymer Chemistry
4	VI	UG21CH6CB05	Soil and Agricultural Chemistry
5	VI	UG21CH6CB02	Computer Applications in Chemistry
6	VI	UG21CH6CB03	Pharmaceutical Chemistry
7	VI	UG21CH6CB04	Petrochemicals

CONSOLIDATED SCHEME FOR I TO IV SEMESTERS

PROGRAMME STRUCTURE

1. BSC CHEMISTRY COMPLEMENTARY

Semester	Title with Course Code	Hours per week	Credits
I	Basic Theoretical and Analytical Chemistry	36	2
	Volumetric Analysis	72	2
II	Organic and Nuclear Chemistry	36	2
	Volumetric Analysis	72	2
III	Physical Chemistry - I	54	3
	Physical Chemistry Practicals	72	2
III	Organic and Bio-organic Chemistry	54	3
	Organic Chemistry Practicals	72	2
IV	Physical Chemistry – II	54	3
	Physical Chemistry Practicals	72	2
IV	Advanced Bio-organic Chemistry	54	3
	Organic Chemistry Practicals	72	2

Titles and Codes of Courses offered by the Department

Semester	Theory / Practical	Course Title	Course Code
I	Core Theory	Theoretical and Inorganic Chemistry	UG21CH1CR01
II	Core Theory	Theoretical and Analytical Chemistry	UG21CH2CR01
I & II Combined	Core Practical	Volumetric Analysis	UG21CH2CRP1
III	Core Theory	Organic Chemistry-I	UG21CH3CR01
IV	Core Theory	Organic Chemistry-II	UG21CH4CR01
III & IV Combined	Core Practical	Qualitative Organic Analysis	UG21CH4CRP1
V	Core Theory	Environmental Studies and Human Rights	UG21CH5CR01
V	Core Theory	Organic Chemistry-III	UG21CH5CR02
V	Core Theory	Physical Chemistry – I	UG21CH5CR03
V	Core Theory	Physical Chemistry – II	UG21CH5CR04
V	Open course Theory	Chemistry in Everyday Life	UG21CH5OC01
VI	Core Theory	Coordination Chemistry and Organometallics	UG21CH6CR01
VI	Core Theory	Organic Chemistry-IV	UG21CH6CR02
VI	Core Theory	Physical Chemistry – III	UG21CH6CR03
VI	Core Theory	Physical Chemistry - IV	UG21CH6CR04
VI	Choice Based Course Theory	Polymer Chemistry	UG21CH6CB01

V & VI Combined	Core Practical	Qualitative Inorganic Analysis	UG21CH6CRP1
V & VI Combined	Core Practical	Preparation and Basic Laboratory Skills	UG21CH6CRP2
V & VI Combined	Core Practical	Physical Chemistry Practicals	UG21CH6CRP3
V & VI Combined	Core Practical	Gravimetric Analysis	UG21CH6CRP4
VI	Core Project& Viva	Project& Viva	UG21CH6PV
I	Complementary Theory (For Phy/Zoo/Bot)	Basic Theoretical and Analytical Chemistry	UG21CH1CM01
II	Complementary Theory (For Phy/Zoo/Bot)	Organic & Nuclear Chemistry	UG21CH2CM01
I & II Combined	Complementary Practical (For Phy/Zoo/Bot)	Volumetric Analysis	UG21CH2CMP1
III	Complementary Theory (For Phy)	Physical Chemistry- I	UG21CH3CM01
III	Complementary Theory (For Zoo/Bot)	Organic & Bio-organic Chemistry	UG21CH3CM02
IV	Complementary Theory (For Phy)	Physical Chemistry- I	UG21CH4CM01
IV	Complementary Theory (For Zoo/Bot)	Advanced Bio-Organic Chemistry	UG21CH4CM02
III & IV Combined	Complementary Practical (For Phy)	Physical Chemistry Practicals	UG21CH4CMP1
III & IV Combined	Complementary Practical (For Zoo/Bot)	Organic Chemistry Practicals	UG21CH4CMP2

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

PROGRAMME OBJECTIVES

To extend the depth and breadth of knowledge in all branches of chemistry to provide an excellent foundation for any kind of career of scientific leadership in academia and industry.

UNDER GRADUATE PROGRAMME OUTCOMES

PO No.	Upon completion of undergraduate programme, the students will be able to:
PO-1	Apply and innovate
PO-2	Achieve a desire for higher learning
PO-3	Work as a team with enhanced communication and coordination skills
PO-4	Attain skills for employment and entrepreneurship
PO-5	Acquire awareness on socio-cultural and environmental issues
PO-6	Develop a sense of ethics, self-discipline and sustainability

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO No.	Upon completion of BSc Chemistry programme, the students will be able to:	PO No.
PSO-1	Acquire a comprehensive knowledge and understanding of the major areas of inorganic, organic, theoretical and physical chemistry including a wide range of other disciplinary subjects such as analytical, bio- and industrial chemistry	1, 2, 3

PSO-2	Interpret chemical information verbally, mathematically and graphically	1, 2, 4,5
PSO-3	Develop a sense of inquiry and problem solving ability to pursue higher studies and succeed in competitive examinations.	1, 2, 3,4, 5,6
PSO-4	Apply the concepts and techniques in Mathematics and Physics as tools to learn Chemistry.	1,2,4
PSO-5	Demonstrate writing, speaking, reading and listening competence in two languages.	1,2,3,4,6
PSO-6	Achieve laboratory skills needed to design safe, eco-friendly and novel chemical experiments to succeed in graduate and professional school, chemical industry and research	1, 2, 3,4, 5,6
PSO-7	Use computers for chemical simulations and data analysis.	1,2, 3,4
PSO-8	Illustrate environmental issues and human rights for generating a novel society.	1,4,5,6

CAREER OPPORTUNITIES

1. Scientists or Chemists in private, government and research institutions.
2. Academicians or researchers in higher educational institutions, following further degree qualifications at Masters or PhD levels.
3. Officers in agencies or industries in which sound knowledge of chemistry and higher levels of generic skills are required.

DETAILED SYLLABUS OF B Sc CHEMISTRY PROGRAMME

SEMESTER ONE

Semester **I**	Code: **UG21CH1CR01**	**THEORETICAL AND INORGANIC CHEMISTRY**	Total Hrs:36	Credits:2

Course Objectives

Objectives

- To study various atom models.
- To understand the features of quantum mechanics
- To study the periodic properties of elements.
- To familiarize selected important compounds of main group elements
- To study the analytical principles and good laboratory practices and to develop skills required for qualitative and quantitative inorganic analysis.

Syllabus

1. Atomic Structure (6 hrs)

Black body radiation-Planck's quantum hypothesis - Photoelectric effect - Compton effect - Atomic spectra of hydrogen and hydrogen like atoms– Bohr theory of atom – Calculation of Bohr radius, velocity and energy of an electron - Explanation of atomic spectra - Limitations of Bohr theory - Sommerfeld modification. Louis de Broglie's matter waves – Wave-particle duality - Electron diffraction - Heisenberg's uncertainty principle.

2. Quantum mechanics (12 hrs)

Postulates of quantum mechanics, Sc

hrödinger wave equation, Significance of ψ and ψ^2, well behaved wave functions, concept of operators, eigen functions, eigen values -Particle in one-dimensional box – derivation for energy, application to linear conjugated polyene (butadiene).

Introductory treatment of Schrödinger equation for hydrogen atom. Atomic orbitals-Shapes of orbitals (s, p and d) - Quantum numbers - importance, hydrogen like wave functions – radial and angular wave functions.

Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle – Electronic configuration of atoms. Zeeman effect and Stark effect, Stern-Gerlac experiment, Energy level diagram of a multielectron atom.

3. Periodic Table and Periodic Properties (6 hrs)

Modern periodic law – Long form of periodic table. Periodicity in properties (s and p block elements): Atomic and ionic radii - Ionization enthalpy - Electron affinity (electron gain enthalpy

– Electronegativity. Electronegativity scales: Pauling and Mullikan scales. Effective nuclear charge – Slater rule and its applications – Polarising power. Inert pair effect, Diagonal relationship and anomalous behavior of first element in a group.

4. Chemistry of s and p block elements (8 hrs)

Selected compounds of main group elements- Boron hydrides – diborane (preparation, properties and bonding), B_5H_9, B_4H_{10}- Styx numbers. Boron nitride, borazine. Allotropy in C, S and P. Peroxy acids of sulphur peroxymonosulphuric acid, peroxy disulphuric acid. Oxy acids of halogens (structure only), interhalogen compounds, pseudohalogens, fluorocarbons.

Properties of noble gases- Separation of noble gases- Compounds of noble gases: Fluorides, oxides and oxy fluorides of xenon (structure only)

5. Data analysis and laboratory practices (4 hrs)

Precision and accuracy – Ways of expressing precision -Types of errors – Methods to reduce systematic errors. Mean and standard deviation – distribution of random errors– confidence limits – tests of significance – F test and t test.

(Non evaluative topics): Laboratory hygiene and safety- storage and handling of chemicals. Laboratory signs- Simple first aids: electric shocks, fire, cut glass, inhalation of poisonous gases, accidents due to acids and alkalies, burns due to phenol and bromine. Disposal of sodium and broken mercury thermometer. Awareness of material safety data sheet (MSDS). Good Laboratory Practices.

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1. Peter Atkins and Julio de PaulaPhysical Chemistry, 9th Edition
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15. Satya Prakash et.al, *Advanced Inorganic Chemistry, Volume 1 &2,* S. Chand and Sons, New Delhi, 19th edition.

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**

Course Outcomes

CO No :	Upon completion of B.Sc Chemistry Programme, the students will be able to	Knowledge Level	PSO No:
1	Explain the features and limitations of various models of atomic structure	K2	1,2,4
2	To apply the principles of quantum mechanics to describe atomic structure.	K3	1,2,4
3	To apply Schrödinger equation in simple systems and understanding the quantum mechanical concepts in bonding theory	K3	1,2,4
4	To acquire a thorough knowledge about the long form of the periodic table and periodic properties of elements.	K2	1
5	To understand the chemistry of some selected important compounds of main group	K2	1
6	To evaluate errors in chemical analysis.	K5	1
7	To develop skills required for data analysis and good laboratory practices	K6	1,6,7

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

SEMESTER TWO

Semester **II**	Code: **UG21CH2CR01**	**THEORETICAL AND ANALYTICAL CHEMISTRY**	Total Hrs:36	Credits:2

Course Objectives

Objectives

- To explain the formation of different types of bonds
- To predict the geometry of simple molecules
- To explain the different types of hybridization and draw shapes of simple covalent molecules
- To understand the molecular orbital theory of diatomic molecules

Syllabus

1. Chemical Bonding I (10 hrs)

Introduction – Octet rule and its limitations. Brief introduction on types of bonds- Ionic, covalent, coordinate covalent and metallic bonds, intermolecular forces.

Ionic Bond: Factors favouring the formation of ionic bonds - Lattice energy of ionic compounds - Solvation enthalpy and solubility of ionic compounds – Born-Haber cycle and its applications.

Covalent Bond: sigma and pi bonds-Valence Bond Theory- Limitations of VBT. Hybridization: Definition and characteristics - sp ($BeCl_2$, C_2H_2), sp^2 (BF_3, C_2H_4), sp^3 (CH_4, NH_3, H_2O, NH_4^+, H_3O^+ and SO_4^{2-}), sp^3d (PCl_5), sp^3d^2 (SF_6) and sp^3d^3 (IF_7) hybridizations. VSEPR theory: Postulates - Applications - Shapes of molecules - BeF_2, BCl_3, CCl_4, NH_3, H_2O, PF_5, SF_4, ClF_3, XeF_2, SF_6, IF_5, XeF_4, IF_7 and XeF_6.

Comparison of properties of ionic and covalent compounds: Polarisation of ions – Fajan's rule and its applications.-Polarity of bonds – Percentage of ionic character – Dipole moment and molecular structure.

2. Chemical Bonding II (8 hrs)

Molecular Orbital Theory – LCAO - Bonding and anti bonding molecular orbitals – Bond order and its significance. MO diagrams of homonuclear and heteronuclear diatomic molecules: H_2, He_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, CO and NO – Comparison of bond length, magnetic behavior and bond energy of O_2, O_2^+, O_2^{2+}, O_2^- and O_2^{2-}. Comparison of VB and MO theories.

Intermolecular Forces: Introduction. Hydrogen bond: Intra and inter molecular hydrogen bonds – Effect on physical properties. Induction forces and dispersion forces: Van der Waals forces, ion-dipole, dipole-dipole, dipole-induced dipole and induced dipole-induced dipole interactions

3. Metallic Bond: (5 hrs)

Free electron theory and band theory - Thermal and electrical and magnetic properties, boiling point, mechanical properties based on these theories. Classification as insulators, semiconductors and metallic conductors based on band theory

4. Fundamental concepts of analytical chemistry (4hrs)

Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm and ppb. Primary standard-secondary standard, quantitative dilution – problems.

Introduction of micro scale experiments and their advantages.

5. Analytical Techniques (9 hrs)

Chromatography: Column Chromatography - Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications.

Thin Layer Chromatography - Principle, Rf- Values, significance of Rf values.

Paper Chromatography - Principle, Solvents used, Development of Chromatogram

Ion - Exchange Chromatography – Principle - Experimental techniques.

Gas Liquid Chromatography - Principle - Experimental techniques - Instrumentation and applications.

High Performance Liquid Chromatography- Principle - Experimental techniques - Instrumentation and applications

References

1. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London.
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5. J. Mendham, R.C. Denney, J. D. Barnes and M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th Edition, Pearson Education, Noida, 2013.
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QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**

Course Outcomes

CO No :	Upon completion of B.Sc Chemistry Programme, the students will be able to	Knowledge Level	PSO No:
1	Distinguish the type of chemical bonding	K1, K2	1
2	Predict the shape of molecules based on various bonding theories.	K3	1,2,3
3	Acquire knowledge about intermolecular forces	K2	1
4	Explain the features of metallic bonding.	K2	1,2

5	Understand the fundamental concepts of analytical chemistry.	K2	1,4,6
6	Appreciate the advantages of micro scale experiments in chemistry.	K4	1,6
7	Familiarize with various chromatographic techniques	K2	1,6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

Semester I & II Practicals
Practical: UG21CH2CRP1 VOLUMETRIC ANALYSIS

Credits - 2 **(36 + 36 hrs)**

Semester **I**	Code: **UG21CH2CRP01**	**THEORETICAL AND INORGANIC CHEMISTRY**	Total Hrs:36	Credits:2

Course Objectives

Objectives

Microscale Analysis can be incorporated for estimation by volumetric analysis.

A. Acidimetry and alkalimetry (Double burette method)

1. Strong acid – Weak base
2. Strong base – Weak acid
3. Estimation of Na_2CO_3 and $NaHCO_3$ in a mixture
4. Estimation of NaOH and Na_2CO_3 in a mixture
5. Estimation of ammonia in ammonium salts by direct and indirect methods

B. Complexometry (Double burette method)

1. Estimation of Zn using EDTA
2. Estimation of Mg using EDTA
3. Estimation of Mg and Ca in a mixture
4. Estimation of Ni
5. Determination of hardness of water

C. Permanganometry

1. Estimation of Ferrous iron
2. Estimation of Oxalic acid
3. Estimation of Sodium oxalate
4. Estimation of Calcium

D. Dichrometry

1. Estimation of Ferrous iron using internal indicator
2. Estimation of Ferrous iron using external indicator
3. Estimation of Ferric iron – reduction with $SnCl_2$

E. Iodometry and Iodimetry

1. Estimation of As_2O_3 and arsenite.
2. Estimation of Cu in a copper salt.

References

1. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson (Chapters 13,14)
2. Vogel's Textbook of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd.(Chapter 10)
3. G. D. Christian, Analytical Chemistry, JohnWiley and Sons(Chapter12)
4. R. D. Day, A. L. Underwood, Quantitative analysis,6th Edn.,PrenticeHallof India Pvt. Ltd
5. Prof. S. Vijayakumar, Dr. M.R. Sudarsankumar, Dr. K. Sankar, Dr. S. Balachandran, Practical Chemistry, B.Sc Degree Programme in Chemistry, Souparnika Publications

SEMESTER THREE

Semester **III**	Code: **UG21CH3CR01**	**ORGANIC CHEMISTRY- I**	Total Hrs: 54	Credits:3

Course Objectives

Objectives

- To have a basic understanding about the classification and nomenclature of organic compounds, fundamentals of organic reaction mechanism, aromaticity and stereochemistry
- To make students capable of understanding and studying organic reactions.
- To have exposure to various emerging new areas of organic chemistry.
- To develop skills required for the qualitative analysis of organic compounds.

Outcome

1. Familiarize the classification and nomenclature of organic compounds
2. Discuss the basic concepts, mechanism and factors which affect the reaction rate of different organic reactions
3. Understand the basic concepts of stereochemistry and conformational analysis of organic molecules
4. Interpret the concept of resonance and aromaticity
5. Explain the reaction mechanism of aromatic electrophilic and nucleophilic substitution reactions
6. Describe the structure and reactions of polynuclear hydrocarbons

Syllabus

1. Classification and nomenclature of organic compounds (5 hrs)

Classification of organic compounds-Rules of IUPAC system of nomenclature of common organic compounds – alkanes, alkenes, alkynes, alkadienes (conjugated and isolated dienes), cycloalkanes, alkyl halides, alcohols and phenols, aldehydes, ketones, carboxylic acids and its derivatives, amines and nitro compounds (both aliphatic and aromatic).

References

1. I. L. Finar Organic Chemistry -, 6th Edition. Vol.- I, Pearson Education (p-26,70,93,131,531, 145,176, 202, 223,245,256,367,360,571)
2. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry' 3rd Edition, Visal Publishing Company Co. (p.92-112)
3. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter 3).
4. S. C. Pal, Nomenclature of Organic Compounds, Narosa Publishing Company

Further Reading

1. P. Y. Bruce, 'Organic Chemistry' - 3rd Edn. Pearson Education. (Chapter-1)
2. C. N. Pillai 'Organic Chemistry' Universities Press.

3. Basic concepts of reaction mechanism (15 Hrs)

Meaning of reaction mechanism-Nature of bond fission: –Homolysis and Heterolysis. Types of reagents- Electrophiles and Nucleophiles. Electron displacement effects:- inductive, inductomeric, electromeric, Mesomeric (Resonance), hyper conjugative and steric effects.

Reaction intermediates: Free radicals, carbocations, carbanions (structure, formation and stability).

Types of organic reactions-Aliphatic nucleophilic substitutions: - SN_1 and SN_2 mechanism. Factors affecting the rate of substitution reactions: Effect of substrate, solvent, nucleophile and leaving groups. Stereochemistry-Walden inversion.

Elimination Reactions: - E1 and E2 elimination, mechanism-Hoffmann and Saytzeff rules. Elimination versus substitution

Addition reactions:- Addition of halogens and hydrogen halides. Mechanisms of addition of Br_2 and hydrogen halides to double bonds- Markownikoff's rule, peroxide effect. Test for unsaturation - Bromine water, Baeyer's reagent. 1, 4 and 1,2- addition in butadienes.

References

1. Peter Sykes, A Guide book to Mechanism in Organic Chemistry: 6 th Edition, Pearson Education. (chapters 1,4,5,6,7,8,9,10)
2. P. S. Kalsi' 'Organic Reactions and their Mechanisms'' New Age International Publishers. (Chapters- 4, 5,11,12,16)

3. K.S. Tewari and N.K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House. (Chapter 5)
4. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Vishal Publishing Company Co. (Chapter 3,4)
5. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India,(Chapters-5,8,9).
6. I. L. Finar Organic Chemistry, 6th Edition. Vol.- I, Pearson(chapters-4,5,20,21)

Further Reading

1. J. March, 'Advanced Organic Chemistry', IV Edn, John Wiley & Sons, NY.
2. S. M. Mukhergi and S.P. Singh 'Reaction Mechanism In Organic Chemistry', Macmillan
3. Reinhard Bruckner, 'Advanced Organic Chemistry' Elsevier
4. J. C layden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press
5. V. K. Ahluwalia, Green Chemistry, Ane Books India.

4. Stereochemistry (16 hrs)

Projection formulae - Fischer, flying wedge, sawhorse and newman projection formulae. Stereoisomerism - definition - classification.Introduction to molecular symmetry and chirality: examples from common objects to molecules. Axis, plane, center, alternating axis of symmetry.

Optical isomerism - Optical activity - conditions for optical activity - asymmetric centre - Enantiomers, Diastereomers, Meso compounds-optical isomers in glyceraldehyde, lactic acid and tartaric acid. D ,L notation- cahn-Ingold-Prelog rules – R,S notations for optical isomers with one and two asymmetric carbon atoms-erythro and threo representation. Racemisation - methods of racemisation -Resolution - methods of resolution - Asymmetric synthesis

Geometrical isomerism - Cis-trans, syn-anti and E-Z notations - geometrical isomerism in unsaturated compounds , cyclic compounds, aldoximes and ketoximes- Interconversion of cis-trans isomers.

Conformational analysis – conformers-configuration-factors affecting the stability of organic molecules-Conformational analysis of ethane and n-butane including energy diagrams – Cyclo alkanes relative stabilities-Baeyers strain theory-conformation of

cyclohexane (chair, boat and skew boat forms) - axial and equatorial bonds- ring flipping showing axial equatorial interconversions, conformation of methylcyclohexane.

References

1. R. T. Morrison and R.N Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapters-4,13)
2. I. L. Finar, 'Organic Chemistry '- Vol.- 6 th Edition I, Pearson Education (Chapters-3,4,17)
3. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Vishal Publishing Company Co. (Chapters-6,7)
4. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House. (Chapter-6)

Further Reading

1. D. Nasipuri 'Stereochemistry of Organic Compounds', New Age International Publishers
2. P. S. Kalsi' 'Stereochemistry, Conformation and Mechanisms'' New Age International Publishers.
3. C. N. Pillai 'Organic Chemistry' Universities Press.
4. P. Y. Bruice, 'Organic Chemistry' - 3rd Edn. Pearson Education. 20
5. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press

5. Aromaticity (18 hrs)

Resonance: - Concept of resonance, resonance energy. Structure & stability of alkenes, butadienes and Benzene-heat of hydrogenation and heat of combustion-orbital picture of benzene.

Aromaticity:- Concept of aromaticity – Huckel's rule –Definition- Application of Huckel's rule to Benzenoid – (benzene, naphthalene and anthracene) and Non–benzenoid compounds– (furan, pyrrole, indole, quinoline, cyclopropenyl cation, cyclopentadienyl anion) –Antiaromatic compounds.

Aromatic electrophilic substitution reactions – General mechanism of electrophilic substitution-halogenation, nitration, sulphonation, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution – ortho-para and meta directing groups-Ring activating and deactivating groups with examples.

Aromatic nucleophilic substitutions- S_N2Ar mechanism and Benzyne mechanism.

Polynuclear hydrocarbons: -reactions and structure of naphthalene, anthracene, phenanthrene. Reactivity of naphthalene towards electrophilic substitution:-nitration and sulfonation.

References

1. R. T. Morrison and R.N Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapters- 15,26)
2. I. L. Finar, 'Organic Chemistry '- Vol.- 6th Edition I, Pearson Education (chapters-20,21)
3. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Vishal Publishing Company Co. (Chapters- 14,15,16)
4. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House, (Chapter- 11,12)
5. Peter Sykes, A Guide book to Mechanism in Organic Chemistry :, 6th Edition, Pearson Education (Chapter 6)

Further Reading

1. P. S. Kalsi' 'Organic Reactions and their Mechanisms'' New Age International Publishers. (Chapters-4,5,11,12,16)
2. S. H. Pine 'Organic Chemistry' - - McGraw Hill
3. J. March, 'Advanced Organic Chemistry', IV Edn, John Wiley & Sons, NY
4. Paula Y. Bruice, 'Organic Chemistry' - 3rdEdn. Pearson Education.

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	12	9	4	25
No. Questions to be answered	10	6	2	18

Course Outcomes

CO No :	Upon completion of B.Sc Chemistry Programme, the students will be able to	Knowledge Level	PSO No:
1	Familiarize the classification and nomenclature of organic compounds	K1	1,2
2	Discuss the basic concepts, mechanism and factors which affect the reaction rate of different organic reactions	K2,,K4	1, 3
3	Understand the basic concepts of stereochemistry and conformational analysis of organic molecules	K2,K3	1,2
4	Interpret the concept of resonance and aromaticity	K4	1, 2
5	Explain the reaction mechanism of aromatic electrophilic and nucleophilic substitution reactions	K2,K3	1
6	Describe the structure and reactions of polynuclear hydrocarbons	K2,K3	1,2,3
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

SEMESTER FOUR

Semester **IV**	Code: **UG21CH4CR01**	**ORGANIC CHEMISTRY- II**	Total Hrs: 54	Credits:3

Course Objectives

Objectives

To enable the students-

- To learn the chemistry of alcohols, phenols, carboxylic acids, derivatives of carboxylic acids, sulphonic acids, carbonyl compounds, active methylene compounds and compounds containing nitrogen atom.
- To understand and study organic reaction mechanisms.
- To develop skills required for the qualitative analysis of organic compounds

Course outcome

1. Discuss the classification, methods of preparation, physical/chemical properties and reactions of alcohols, phenols, ethers and epoxides
2. Recognize the chemical reactions and mechanisms of carbonyl compoundsandactive methylene compounds
3. Explain the structure, acidity and chemical reactions of carboxylic acids and benzene sulphonic acids
4. Interpret the methods of preparation and chemical reactions of unsaturated, hydroxyl and dicarboxylic acids
5. Understand the preparation and reactions of derivatives of carboxylic acids
6. Explain the method of preparation, reactions and structure of carbonic acid derivatives

Syllabus

1. Alcohols, Phenols, Ethers and Epoxides (18 hrs)

Alcohols **:-**Mono, di and trihydric alcohols- Monohydric alcohols:- Classification, classical methods of preparation of methanol and ethanol, physical properties– hydrogen bonding- distinction between primary, secondary and tertiary alcohols- Ascending and descending in alcohol series, chemistry of methanol poisoning, harmful effects of ethanol on human body.

Dihydric alcohols:- Ethylene glycol- Oxidative cleavage (Lead tetra acetate, Periodic acid), Pinacol - Pinacolone rearrangement – mechanism.

Phenols: – Acidity of phenols- effects of substituents – comparison of acidity with alcohols. Reactions of phenol, Formation of phenolphthalein and azodyes. Preparation and uses of nitrophenols, picric acid, catechol, resorcinol and quinol, Mechanisms of Reimer –Tiemann reaction, Lederer- Mannase reaction, Fries Rearrangement. Liebermann's nitroso reaction.

Ethers:- Williamsons synthesis, Cleavage of ether linkages by HI, Zeisel's method of estimation of alkoxy groups.

Epoxides:- Preparation from alkenes, acid and base catalyzed ring opening reactions, Crown ethers (elementary idea only)

References

1. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India, (Chapters-6, 24)
2. I. L. Finar Organic Chemistry -, 6th Edition. Vol.- I, Pearson. (6,8,11,26)
3. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Vishal Publishing Company Co. (Chapters-19,20)
4. K.S. Tewari and N K Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House(Chapters-16,17) 24

Further reading

1. B. S. Bahl 'Advanced organic Chemistry', S. Chand.
2. John Mc Murry, 'Organic Chemistry' - Vth Edition -Thompson Asia Pvt Ltd
3. C. N. Pillai 'Organic Chemistry' Universities Press.

2. Aldehydes, Ketones and active methylene compounds (18 Hrs)

Structure and reactivity of the carbonyl group - acidity of alpha hydrogen. Reactions of aldehydes and ketones- Addition and condensation reactions. Comparative studies of aldehydes and ketones.

Mechanisms of the following reactions: Claisen, Claisen-Schmidt, Benzoin, Aldol, Perkin, Knoevenagel condensations, Cannizzaro's reaction Wittig reaction.

Condensation with ammonia and its derivatives, Mannich reaction.

Oxidation and reduction reactions- Baeyer-Villiger oxidation, Clemmensen, Wolff-Kishner, Meerwein-Ponndorf-Verley reduction, $LiAlH_4$ and $NaBH_4$reductions.

Compounds containing active methylene groups: - Keto-enol tautomerism, Synthesis and applications of malonic ester, acetoacetic ester and cyanoacetic ester.

References

1. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapter-18)
2. I. L. Finar, Organic Chemistry 6 th Edition, Vol.- I, Pearson. ((Chapters-8,27) 25
3. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-22)
4. K.S Tewari and NK Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-19)
5. B.S. Bahl 'Advanced organic Chemistry', S. Chand

Further reading

1. Paula Y. Bruice, 'Organic Chemistry' - 3 rdEdn. Pearson Education Asia.
2. John Mc Murry, 'Organic Chemistry' - Vth Edition -Thompson Asia Pvt Ltd
3. C.N.Pillai 'Organic Chemistry' Universities Press.

3. Carboxylic acids, sulphonic acids and its derivatives (15 Hrs)

Carboxylic acid:-Structure – Acidity- effects of substituents on the acid strength of carboxylic acids- reactions of carboxylic acid-ascending and descending in acid series, Arndt-Eistert synthesis (Wolff rearrangement to be mentioned), Hell-Volhard-Zelinsky reaction, Kolbe's electrolysis.

Methods of preparation and chemical reactions of anthranilic acid, unsaturated acids (cinnamic acid, acrylic acid), hydroxy acids (malic acid, citric acid), dicarboxylic acids (oxalic acid, malonic acid, adipic acid, maleic acid, fumaric acid).

Preparation of functional derivatives of carboxylic acids- acid chlorides, esters, anhydrides and amides – their importance.

Preparation and reactions of benzene sulphonic acids and sulphonyl chlorides – Hinsberg reagent. Comparison of acidity of carboxylic acids and sulphonic acids.

4. Carbonic acid derivatives (3 Hrs)

Carbonic acid derivatives:-Preparation, reactions and structure of urea, thiourea and semicarbazide, Manufacture of urea. Preparation and basicity of guanidine.

References

1. R.T. Morrison and R.N. Boyd, Organic Chemistry, 6th Edn., Prentice Hall of India,1992.
2. I. L. Finar, Organic Chemistry, 6th Edn.,Vol. I, Pearson, 1973.

3. M. K. Jain and S.C. Sharma, Modern Organic Chemistry, 4th Edn., Vishal Publishing Company Co Ltd., 2003.

4. K.S. Tewari and N. K. Vishnoi, A Text book of Organic Chemistry, 3rd Edn., Vikas Publishing House, 2006.

5. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand & Company, New Delhi, 2010.

6. V.K. Ahluwalia, Organic Reaction Mechanisms, 4th Edn., Narosa Publishing House,New Delhi, 2013.

Further reading

1. John Mc Murry, Organic Chemistry, 8th Edn., Thompson Asia Pvt. Ltd., 2011.
2. C.N. Pillai, Organic Chemistry, Universities Press, 2009.
3. P.Y. Bruice, Organic Chemistry, 4th Edn., Pearson Education Asia, 2000.

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be Answered	**10**	**6**	**2**	**18**

Course Outcome

CO No :	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No :
1	Discuss the classification, methods of preparation, physical/chemical properties and reactions of alcohols, phenols, ethers and epoxides	K1,K2,K3	1,6
2	Recognize the chemical reactions and mechanisms of carbonyl compounds and active methylene compounds	K2,K3	1,6

3	Explain the structure, acidity and chemical reactions of carboxylic acids and benzene sulphonic acids	K2,K4	1
4	Interpret the methods of preparation and chemical reactions of unsaturated, hydroxyl and dicarboxylic acids	K3,K4	1,2,6
5	Understand the preparation and reactions of derivatives of carboxylic acids	K2,K5	1,2
6	Understand the preparation and reactions of derivatives of carboxylic acids	K2,K5	1,2
7	Explain the method of preparation, reactions and structure of carbonic acid derivatives.	K2,K4	1,3
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

III & IV Semester Practicals
Practical: UG21CH4CRP1 - QUALITATIVE ORGANIC ANALYSIS

Credit -2 **(36 + 36 hrs)**

Course Objectives

Course Objectives

Objectives:

1. Develop skills in synthesis and characterization of specified organic compounds using documented laboratory procedures.
2. Identify organic compounds using classical and modern laboratory methods.

Syllabus

1. Determination of Physical constants of solids and liquids
2. Tests for elements: Nitrogen, Halogens and Sulphur (Microscale methods)
3. Tests for unsaturation
4. Tests for aromatic character.
5. Systematic analysis of the following organic compounds and characterization with its physical constant and a derivative :

aldehyde, ketone, carboxylic acid, 1,2 dicarboxylic acid, unsaturated acid, phenolic acid, ester, primary amines, amide, diamide, polynuclear hydrocarbons, reducing and non-reducing sugars, phenol, nitro and halogen compounds (halogen in the nucleus and side chain).

(Minimum ten compounds to be analysed)

References

1. 'Vogel's Textbook of Practical Organic Chemistry' Pearson Education
2. F. G. Mann and B. C. Saunders, 'Practical Organic Chemistry' *Fourth Edition,* Pearson Education.
3. V.K.Ahluwalia and S. Dhingra ' Comprehensive Practical Organic Chemistry' Universities
4. A. I. Vogel, 'A Text Book of Practical Organic Chemistry', Longman.

Course Outcome:

CO No:	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No:
1	Explain the chemistry of common organic chemistry reactions	K2	1, 6
2	Analyse various organic compounds using documented procedures	K1	1,6
3	Synthesise specific organic compounds using documented procedures	K3	1,6
4	Determine the physical constants	K5	1,6
5	Classify organic compounds based on functional groups	K3	1,6
6	Distinguish the reactions of various functional group	K3	1,6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

SEMESTER FIVE

Semester **V**	Code: **UG21CH5CR01**	**ENVIRNOMENTAL STUDIES AND HUMAN RIGHTS**	Total Hrs: 72	Credits:4

Course Objectives

Objectives

To study:

- Environmental management and impact assessment
- Toxic effects of pollutants
- Air, water, and soil pollution
- The concept of Human Rights and nature of Human rights violations.

Syllabus

1. Energy and Environment (12 Hrs)

India's Energy Scenario, Optimising excess air and combustion; Energy Related Emissions; Need for conservation of energy, energy conservation opportunities - Renewable energy sources- solar energy- solar thermal and photovoltaics, wind energy, geothermal energy-Non renewable energy sources-fossil fuels- non conventional energy sources-Tidal, geothermal, biofuels. Fuel of the future- Hydrogen; Fuel Cells; Biofuels; Green Building; Green materials for building construction; Green Building Certification- LEED, GRIHA.

Environmental management Standards: ISO 14000 Series; Life Cycle Analysis (LCA); Bio-mimicking; Environmental Impact Assessment (EIA); Environment Protection Act (EPA).

2. Air pollution (16 Hrs)

Primary and secondary pollutants, Volatile Organic Compounds (VOC), NO_2, SO_2, O_3, PAN, dioxins, chlorofluoro hydrocarbons and substitutes, hydrogen sulphide, fly ash,- photochemical smog, particulates- PM_{10} and $PM_{2.5}$, major pollutants in automobile exhaust, Effects of atmospheric pollution -acid rain, smog; green-house effect, global warming- ozone layer depletion, climate change. Indoorairpollution.Vehicle Emission Standards; Ambient Air Quality Standards in India.

Air pollutant monitoring methods: Filtration, sedimentation, electrostatic samplers, thermal precipitator, impingers. Analytical methods: High volume sampler method for particulates; GC method for CO; Chemilminescence and spectrophotometry for NO_2; West-Gaeke spectrophotometric method for SO_2, titration method for H_2S.

Regional Episodes: Bhopal gas tragedy; Endosulfan tragedy in Kasargod.

Control measures: Gravitational settling chambers; Fabric filters; Wet scrubber; Catalytic converters; cyclone collectors; electrostatic precipitators, Extraction ventilation to eliminate dust; Coke based chemical fume absorbers; zoning; Green Belt.

Noise pollution, Noise control measures. Noise level Standards.

3. Water pollution (16 Hrs)

Sources of water pollution. Pesticide pollution, Thermal pollution, Methods to control water pollution.

Drinking water and effluent water quality standards; Sampling methods; Significance and health effects of water quality parameters: pH, EC, turbidity, TDS, salinity, COD, BOD, DO, CN, chloride, sulphate. MINAS (Minimal National Standards). Analytical procedures for the determination of these parameters.

Effluent treatment methods- physical, chemical, and biological.

Solid waste Management; Zero waste concept; sanitary landfill and secured landfill, incineration, pyrolysis, biological reprocessing.

Significance of 3R - Reduce, Reuse and Recycling.

4. Chemical toxicology (6 Hrs)

Hazardous chemicals and their management; biomagnification, POPs, pesticides, carcinogenic, tetratogenic and mutagenic substances; Threshold limit value (TLV); STEL (Short Term Exposure Limit); Material Safety Data Sheet (MSDS).Safety precautions during handling, transport and use, Chemistry of fire.

5. Metallurgical operations and its environmental impacts (4 Hrs)

Environmental impacts of metallurgical operations.

Biochemical effects of heavy metals- As, Cd, Pb, Hg, Co and Ni. Minamata and itaiitai diseases

5. Radioactive pollution (5 Hrs)

Radioactive substances used in industrial, agricultural, medical fields.

Types of reactor waste; Health hazards of radioactive fallouts; Potential damages by radioactive radiations; Disposal of radioactive waste (royal waste) - dilute and disperse method, delay and decay method, concentrate and contain method. Recent disposal methods like Reprocessing method, immobilization technique by vitrification.

Nuclear power plants in India, Chernobyl disaster.

6. Green chemistry (4 Hrs)

Green Chemistry:-Introduction-need of green chemistry-twelve principles of green chemistry, atom economy, microwave and ultrasound assisted green synthesis (elementary idea only), green solvents- supercritical fluids.

7. Introduction to Human Rights (9 Hrs)

Types and nature of human rights violations faced by vulnerable groups, namely the Scheduled Castes, Scheduled tribes, Women, Children and Minority communities
Constitutional provisions and laws protecting the rights of vulnerable groups.
Right to Equality, Right to Freedom, Right against Exploitation**.**
Salient features of some important Acts like :
The Prevention of Atrocities (Against SC/ST) Act, 1989; The Domestic Violence Act, 2005; Vishakha Guidelines for Preventing Sexual Harassment at Workplace, 1997; The Child Labour (Prohibition and Regulation) Act, 1986; The Persons With Disabilities (Equal Opportunities, Protection of Rights and Full Participation)Act, 1995;
Redressal mechanisms at the National and State levels:
The National Human Rights Commission (NHRC), the SC/ST Commission, the National Commission for Women; the Minorities Commission

References

1. A. K. De, Environmental Chemistry, New age International Ltd., 7th Edition 2007.

2. G. Tyler Miller, Scott Spoolman, Living in the Environment, Tomson Brooke/Cole, 17th Edition, 2011.
3. N. Manivasakam, Physico-chemical examination of water, sewage and industrial effluents, PragathiPrakashan 2008.
4. D. Clarson, Soil and water analytical methods, ISBN: 81-901483-0-3.
5. R. K. Khitoliya, Environmental Pollution – Management and Control for sustainable development, S.Chand& Company Ltd., 2004.
6. B. B. Kebbekus and S. Mitra, Enveronmental chemical analysis, Blacke Academic & Professional, 1998.
7. S. S. Dara, A Textbook of Environmental chemistry and pollution control, S.Chand& Company Ltd., New Delhi 2004.
8. R. A. Malaviya, Environmental Pollution and its control under international law, Chugh Publications 1987.
9. Pramod Singh, Environmental pollution and management, Chugh Publications 1985.
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11. Nelson L. Nemerow, Industrial water pollution, Addison-Wesley Pub. Co., 1971.
12. James W. Moore and S.Ramamoorthy, Organic chemicals in natural waters, Springer Science & Business Media, 2012.
13. O. Hutzinger, I. H. Van Leyveld and B. C. J Zoeteman. Aquatic pollutants Transformation and Biological Effects, Pergamon Publishers 2013.
14. B.K Sharma and H Kaur, Envirnomental chemistry, GOEL Publication, Meerut, India, 1996.
15. Shivananda, J. Human Rights. Alfa Publications, New Delhi,. 2006.
16. Rajawat, M. Human Rights and Dalits. Anmol Publications, New Delhi, 2005.
17. Kaushal, R. Women & Human Rights in India; Kaveri Books, New Delhi, 2000.
18. Bajpai, A. Child Rights in India; Oxford University Press; New Delhi; 2003.
19. Biju, M.R. Human Rights in a Developing Society; Mittal Publications, New Delhi, 2005.
20. V.K. Ahluwalia, Green Chemistry, Narosa Publishing House, New Delhi, 2011.
21. A.P. Dicks, Green Organic Chemistry in Lecture and Laboratory, CRC Press, University of Toronto, Ontario, Canada, 2016.

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**

Course Outcome

CO No :	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No :
1	Understand the environment functions and how it is affected by human activities.	K2, K4	2,8
2	Acquire knowledge of chemical principles of various environmental phenomena and processes in water and air	K1, K2	8
3	Appreciate the central role of chemistry in our society and use this as a basis for ethical behaviour in issues facing chemists including an understanding of safe handling of chemicals	K4, K5	8
4	Critically discuss local and global environmental issues facing our society in energy, health and medicine and toxic effects of pollutants.	K4, K5	8
5	Describe the practical chemistry in industrial processes including water purification, waste treatment, energy production, and pollution mitigation strategies	K2, K3	2,8

6	Analyze the role of the chemist in measurement and problem solving in environmental studies	K4	2,3,8
7	Sound knowledge about Human Rights , nature of Human rights violations and salient features of some important Acts	K6	8
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

Semester **V**	Code: **UG21CH5CR02**	**ORGANIC CHEMISTRY- III**	Total Hrs:54	Credits:3

Course Objectives

Objectives

- To learn in detail the chemistry of carbohydrates.
- To learn in detail the chemistry of amino acids, proteins and nucleic acids.
- To understand the structure and functions of enzymes, vitamins and lipids
- To study the fundamentals of terpenoids, alkaloids, and steroids,
- To have an elementary idea about Green Fluorescent Proteins.

Syllabus

1. Heterocyclic compounds (9 Hrs)

Aromaticity of heterocyclic compounds

Preparation, properties and uses of furan, pyrrole and thiophene. Synthesis and reactions of pyridine and piperidine - comparative study of basicity of pyrrole, pyridine and piperidine with amines. Synthesis and reactions of quinoline, isoquinoline and indole with special reference to Skraup, Bischler and Napieralskii and Fisher indole synthesis.

References

1. I. L.Finar, Organic Chemistry - Volume I & II - Pearson Education (Chapter 30)
2. M. K.J ain and S. C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-33,34)
3. K. S. Tewari and N. K. Vishnoi, 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-29, 30)
4. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapter-18)
5. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. Organic Chemistry, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
6. Maya Shankar Singh, L.G.Wade, Organic Chemistry, 6th Edition, Pearson Education, New Delhi, 2013.

Further reading

1. John Mc Murry, 'Organic Chemistry' - Vth Edition -Thompson Asia Pvt Ltd
2. C. N. Pillai 'Organic Chemistry' Universities Press.

2. Carbohydrates (12 Hrs)

Classification - Monosaccharides:- Glucose and Fructose- Reactions - osazone formation-Mutarotation.

Cyclic structure- Pyranose and furanose forms. Determination of ring size. Haworth projection formula, Configuration of monosaccharides, epimerisation, chain lengthening and chain shortening of aldoses. Inter conversion of aldoses and ketoses.

Disaccharides: - structure and reactions of sucrose-Ring structure.

Polysaccharides:- Structure and properties of starch and cellulose- Industrial applications of cellulose.

References

1. I. L. Finar, Organic Chemistry - Volume I & II - Pearson Education (Chapter 18)
2. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-35)
3. K. S. Tewari and N. K. Vishnoi, 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-33)
4. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapter-34,35)
5. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, Wiley, 2014.
6. McMurry, J. Organic Chemistry, 7th ed. Cengage Learning, 2013.
7. P.Y. Bruice, Essential Organic Chemistry, 1st Edition, Pearson Education, New Delhi, 2013.

Further reading

1. J. F. Robyt, Essentials of Carbohydrate Chemistry, Springer
2. S. P. Bhutani, Chemistry of Biomolecules, Ane Books Pvt Ltd

3. Terpenoids, steroids and alkaloids (9 Hrs)

Terpenoids : classification, isoprene rule. Essential oils, isolation of essential oils- Structure elucidation of citral and geraniol-Natural rubber – structure, vulcanization and its advantages.

Steroids: Introduction – Diels hydrocarbon- Structure and functions of cholesterol- Elementary idea of HDL, LDL and Vitamin D- steroid hormones.

Alkaloids: Classification, general methods of isolation, structure elucidation of nicotine, coniine, piperine.

References

1. I. L. Finar, Organic Chemistry - Volume I & II - Pearson Education (Chapters 18)
2. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-35)
3. K. S. Tewari and N. K. Vishnoi, 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-33)
4. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapter-34,35)
5. Bhat S.V., Nagasampagi, B.A. & Sivakumar M. Chemistry of Natural Products, Narosa, 2005.
6. Jain, M.K. & Sharma, S.C. Modern Organic Chemistry, Vishal Publishing Co. 2010.
7. Bahl, A. &Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

Further reading

1. J. F. Robyt, Essentials of Carbohydrate Chemistry, Springer
2. S. P. Bhutani, Chemistry of Biomolecules, Ane Books Pvt Ltd

4. Vitamins, Lipids and Enzymes (9 Hrs)

Vitamins: Classification-structure (elucidation not required) of vitamin A, B and C.

Lipids : Biological functions – oils and fats – common fatty acids- extraction and refining- hydrogenation – rancidity- identification of oils and fats – saponification value, acid value, iodine value and RM value.

Enzymes:-Chemical nature and properties of enzymes. Nomenclature and classification of enzymes. Mechanism of enzyme action. Substrate specificity of enzymes. Enzyme inhibition.

References

1. I. L. Finar, Organic Chemistry - Volume I & II - Pearson Education (Chapter 13)
2. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-36)
3. K. S. Tewari and N. K. Vishnoi, 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-34) 2012
4. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapter-36)

Further reading

1. John Mc Murry, 'Organic Chemistry' - Vth Edition -Thompson Asia Pvt Ltd
2. C. N. Pillai 'OrganicChemistry' Universities Press
3. S. P. Bhutani, Chemistry of Biomolecules, Ane Books Pvt Ltd

5. Amino acids, proteins and nucleic acids (12 Hrs)

Amino acids:- classification, Zwitter ion. Preparation of amino acids. Peptides-structure and bonding. Solution phase peptide synthesis and solid phase peptide synthesis.

Proteins:- Classification of proteins based on physical and chemical properties and on physiological functions. Primary, secondary and tertiary structure of proteins, helical and sheet structures (elementary treatment only). Denaturation of proteins-Green Fluorescent Proteins (elementary idea).

Nucleic acids:- Types of nucleic acids -RNA and DNA, polynucleotide chain components - biological functions.

References

1. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-36,37)
2. K. S. Tewari and N. K. Vishnoi, 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-34,35)
3. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapter-36)
4. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry, 7 th ed., W. H. Freeman.
5. Berg, J.M., Tymoczko, J.L. &Stryer, L. Biochemistry, W.H. Freeman, 2002. en.wikipedia.org/wiki/Green_fluorescent_protein
6. www.scholarpedia.org/article/fluorescent_protein
7. www.conncoll.edu/ccacad/zimmer/GFP-ww/timeline.html
8. www.gonda.ucla.edu/bri_core/gfp.htm

Further reading

1. S.P. Bhutani, Chemistry of Biomolecules, Ane Books Pvt. Ltd., 2009.
2. O.P. Agarwal Chemistry of Natural Products, Goel Publications, 1989.
3. John Mc Murry, Organic Chemistry, Thompson Asia Pvt Ltd., 2011.

6. Research in Science

(3hrs)

Research in science- Purpose of research- Types of research- Selecting a topic- Hypothesis-Research design- Scientific writing.

References

1. Garg.B.L., Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R.(2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270 p.

5. Day RA (1992) How to write and publish a scientific paper. Cambridge University press. London.

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be Answered	**10**	**6**	**2**	**18**

Course Outcome

CO No :	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No :
1	Study the fundamentals of heterocyclic compounds	K1, K2	1
2	Understand the structure and functions of enzymes, vitamins and lipids.	K2	1,2
3	Determine the structure, properties and reactions of carbohydrates	K2, K3	1
4	Discuss about the preparation, classification and structure of amino acids, proteins and nucleic acids	K2, K4	1
5	Explain the fundamentals of terpenoids, alkaloids and steroids	K2	1
6	Compare the basicity, aromaticity and reactions of heterocyclic compounds	K4, K5	1,2

7	Develop an idea of the purpose and types of research	K4, K5	3
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

Semester **V**	Code: **UG21CH5CR03**	**PHYSICAL CHEMISTRY-I**	Total Hrs:36	Credits:2

Course Objectives

Objectives

To study

- Intermolecular forces in gases and liquids
- Dynamics of the molecules in the gases and liquids
- Liquefaction of gases
- Structure of solids and defects in crystals

Syllabus

1. Gaseous State (12 hrs)

Postulates of kinetic theory of gases and derivation of the kinetic gas equation. Pressure of an ideal gas, derivation of gas laws. Maxwell's distribution of molecular velocities (graphical representation – derivation not required) Temperature dependence of the Maxwell distribution, molecular velocities. Most probable, average and root mean square velocities (no derivation)

Collision properties: Collision diameter, collision cross section, collision number, collision frequency , mean free path, viscosity of gases – temperature and pressure dependence. Relation between mean free path and coefficient of viscosity.

Barometric distribution law, Law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Real gases: Deviation of real gases from ideal behaviour, compressibility factor z, van der Waals equation of state – derivation and application in explaining real gas behaviour. Virial equation of state, van der Waals equation expressed in virial form – calculation of Boyle temperature, Critical phenomena and Andrews isotherms of CO_2, critical constants.

Liquefaction of gases -Joule-Thomson effect, Claude's process

References

1. P. Atkins and J Paula, The elements of Physical chemistry, 7th edn., Oxford University Press, 9th Edition
2. F. A. Alberty and R J Silby, Physical Chemistry, 3rd Edn, John Wiley, 4th Edition
3. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 1, Macmillan India Ltd 3rd Edition, 2012
4. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co.Jalandhar, 46th Edition, 2013.

2. Liquids (3hrs)

Intermolecular forces in liquids (qualitative idea only)- surface tension ,factors affecting surface tension, viscosity, determination of viscosity by Ostwald's viscometer method. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

References

1. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 1, Macmillan India Ltd 3rd Edition, 2012
2. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co., 46th Edition, 2013

3. Symmetry and Solid state (18 hrs)

Symmetry of molecules-symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, proper and improper axes of symmetry, combination of symmetry elements, molecular point groups, Schoenflies symbol, Group multiplication table of C_{2v}. Determination of point groups of simple molecules like H_2O, NH_3, BF_3, C_6H_6

The nature of the solid state- anisotropy- the law of constancy of interfacial angles, law of rational indices - Miller indices. Seven crystal systems and fourteen Bravais lattices. X-ray diffraction, Bragg's law, detailed study of simple, face centred and body centred cubic systems – Bragg's x-ray diffractometer method and powder pattern method. Analysis of powder diffraction patterns of NaCl, density of cubic crystals, identification of cubic crystal from crystallographic data

Close packing of spheres, ccp and hcp arrangements. Structure of ionic compounds of the type AX (NaCl, CsCl, ZnS) and AX_2 (CaF_2, Na_2O). Defects in crystals – stoichiometric and non-stoichiometric defects, extrinsic and intrinsic defects. Electrical conductivity, semiconductors, n-type, p-type, band theory, Superconductivity – an introduction.

Liquid crystals- thermographic behaviour. Classification, structure of nematic and cholestric phases.

3. Surface Chemistry (3 hrs)

Surface Chemistry -Adsorption – types, adsorption of gases by solids – factors influencing adsorption Freundlich adsorption isotherm – Langmuir adsorption isotherm –derivation of Langmuir adsorption isotherm. The BET theory (no derivation) – use of BET equation for the determination of surface area

References

1. K. L. Kapoor, A Textbook of Physical chemistry, Volume 1, Macmillan India Ltd, 3rd Edition, 2012
2. P. Atkins and J. Paula, The elements of Physical chemistry, 7thedn., Oxford University Press, 9th Edition
3. A. Mc Quarrie, J. D. Simon, Physical Chemistry – A molecular Approach, Viva Books Pvt. Ltd, 1997
4. Surface Chemistry, Anderson
5. Introduction to Surface Chemistry and Catalysis, 2nd Edition, Gabor A. Somorjai, Yimin Li
6. Surface Chemistry and Catalysis, **Carley,** A.F., **Davies**, P., **Hutchings**, G.J., **Spencer,** M.S. (Eds.)

Further Reading

1. A. R. West, Solid State Chemistry and its applications, John Wiley.3rd Edition,1987
2. G. W. Castellan, Physical Chemistry, 3rdedn., Narosa Publishing House, New Delhi, 2011

3. P. W. Atkins, The elements of Physical chemistry, 8thedn., Oxford University Press 2006.
4. S. H. Marron and J. B. Lando, Fundamentals of Physical Chemistry, Macmillan Ltd. 1996.
5. D K Chakrabarty, Adsorption and Catalysis by Solids, New Age India. 2010
6. R E Hummel, Understanding materials science 2nd edn, Springer.
7. G. M. Barrow, Physical Chemistry, 5thedn., Tata McGraw Hill. 2006
8. G. K. Vemulapalli, Physical Chemistry, Prentice-Hall India Pvt. Ltd. 1993
9. W. J. Moore, Basic Physical Chemistry, Orient Longman.4th Edition, 2012
10. W. Adamson and A P Gast, Physical Chemistry of surfaces, John Wiley sons. 6th Edition
11. http://www.iupac.org/dhtml_home.html
12. K. J Laidler, John H.Meiser, Physical Chemistry,2nd edn.2006

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be Answered	**10**	**6**	**2**	**18**

Course Outcome

CO No :	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No :
1	Understand kinetic theory of gases and Maxwell distribution of molecular velocities.	K2	1,2
2	Calculate most probable, root mean square and average velocities.	K3	1,2
3	Interpret the collision properties of gases.	K5	1,2

4	Analyse the deviation of gases from ideal behaviour.	K4	1
5	Apply the intermolecular forces in liquids to determine the surface tension and viscosity of liquids	K3	1
6	Identify the symmetry of solid states and predict the lattice type	K2	1
7	Implement the Braggs equation and powder diffraction techniques to obtain crystallographic data	K3	1,2
8	Distinguish the structure of ionic compounds.	K4	1
9	Identify the defects in crystals		
10	Differentiate the types of liquid crystals and their applications.	K2	1
11	Understand the adsorption techniques determine the surface area from BET data	K2	1
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

Semester **V**	Code: **UG21CH5CR04**	**PHYSICAL CHEMISTRY-II**	Total Hrs:36	Credits:3

Course Objectives

Objectives

- To study the principle and applications of microwave, infrared, Raman, electronic and magnetic resonance spectroscopy.
- To study the fundamentals of mass spectrometry
- To study the fundamentals of photochemistry

Syllabus

1. Molecular spectroscopy (30 hrs)

Introduction to spectroscopy (2 hours)

Electromagnetic radiation, regions of the spectrum, interaction of electromagnetic radiation with molecules, various types of molecular spectroscopic techniques, Born-Oppenheimer approximation.

Rotational spectroscopy (4 hours)

Rotational spectrum: diatomic molecules, energy levels of a rigid rotator, selection rules, determination of bond length.

Vibrational spectroscopy (6 hours)

Vibrational spectrum: the simple harmonic oscillator – energy levels, force constant, selection rules. Anharmonic oscillator, Morse function and Morse curve – pure vibrational spectra of diatomic molecules, selection rules, fundamental frequencies, overtones, hot bands, combination and difference bands, Fermi resonance. Degrees of freedom for polyatomic molecules, concept of group frequencies, finger print region – frequencies of common functional groups in organic compounds.

Raman spectroscopy (4 hours) Raman spectrum: Stokes and antistokes lines, quantum theory of Raman Effect (elementary idea), concept of polarizability, qualitative treatment of pure vibrational Raman spectra of diatomic molecules, selection rules, rule of mutual exclusion.

Electronic spectroscopy (5 hours)

Electronic spectrum: concept of potential energy curves for bonding and anti-bonding molecular orbitals, electronic transition, the Frank-Condon principle, dissociation energy. Polyatomic molecules – qualitative description of σ, π and n- molecular orbitals, their energy levels and the respective transitions.

NMR and ESR spectroscopy (6 hours)

Basic principles of NMR spectroscopy – nuclear spin, Larmor precession. Proton magnetic resonance (^{1}H NMR or PMR) – nuclear shielding and deshielding, chemical shift and molecular structure. Spin-spin splitting and coupling constant. First order spectra – interpretation
of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, ethyl acetate, toluene, acetophenone.

ESR spectroscopy- basic concepts

Mass spectrometry (3 hours)

Mass spectrometry: Basic principle-ionization, fragmentation, separation of ions and representation of the spectrum, application in molecular mass determination

References

1. Mc Quarrie, J. D. Simon, Physical Chemistry – A molecular Approach, Viva Books Pvt. Ltd
2. C. N. Banwell and E M Mc Cash, Fundamentals of molecular spectroscopy 4thedn, TataMc Graw Hill,Chapters 1-4, 6,7
3. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 4, Macmillan India Ltd Chaper 4
4. I. N. Levine, Physical Chemistry, Tata Mc Graw Hill, Chapter 21
5. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co., Chapter 21
6. K. J. Laidler, John H. Meiser, Physical Chemistry,2ndedn, Chapter 14
7. G. Aruldhas, Molecular Structure and Spectroscopy, Prentice Hall of India, 2001
8. D. L. Pavia, G. M. Lampman, G. S. Kriz, Introduction to spectroscopy 3rdedn, Thomson Brooks/Cole, 2001.

Further reading

1. P Atkins, J Poula, Physical Chemistry, 8thedn , OUP
2. D. N. Satyanarayana, Electronic absorption spectroscopy and related techniques, Universities Press.

2. Photochemistry (6 hrs)

Interaction of radiation with matter: Laws of photochemistry – Grothus-Draper law, Stark-Einstein law, examples of photochemical reactions. Beer law and Beer-Lambert's law. Jablonsky diagram, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing).

Quantum yield, primary and secondary processes. Reasons for low and high quantum yield. Basic concepts of photosensitized reactions – photosynthesis, dissociation of hydrogen molecule, isomerization of 2-butene, chemiluminescence and bioluminescence

References

1. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 4, Macmillan India Ltd, Chapter 7
2. I. N. Levine, Physical Chemistry, Tata Mc Graw Hill, Chapter 21
3. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co., Chapter 22, 33rd Edition
4. N. J Turro, Modern Molecular Photochemistry, 4thEdtn, University Science Books, 1991

Further reading

1. K. K. Rohtagi-Mukherjee , Fundamentals of Photochemistry, New Age.
2. K. K. Sharma, L. R. Sharma, A text book of Physical Chemistry, Vikas Publishing house

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	12	9	4	25
No. Questions to be answered	10	6	2	18

Course Outcome

CO No :	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No :
1	Understand the origin of different spectroscopic technique.	K2	1,2,3,4
2	Evaluate bond length using Microwave spectral data	K5	1,2,3,4
3	Differentiate fundamentals and overtones	K4	1,2
4	Sketch Morse curve of diatomic molecules	K2,K3	1,2,4
5	Distinguish between Stoke and Anti Stokes lines	K4	1,2
6	Acquire knowledge to interpret the NMR spectra of simple molecules	K2,K3	1,2,3,4
7	Analysis mass spectrum	K4	1,2,3,4
8	Interpret Jablonski diagram	K5	1,2,4
9	Understand the origin of different spectroscopic technique.	K2	1,2,4
10	Evaluate bond length using Microwave spectral data	K5	1,2,4
11	Understand the adsorption techniques determine the surface area from BET data	K2	1,2,4
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

SEMESTER SIX

Semester **VI**	Code:**UG21CH6CR01**	**COORDINATION CHEMISTRY AND ORGANOMETALLICS**	Total Hrs:54	Credits: 3

Course Objectives

Objectives

- To understand the general characteristics of the d and f block elements
- To study the bonding in coordination compounds
- To understand the applications of coordination compounds
- To understand the classification, properties and applications of organometallic compounds
- To study the methods of preparation, properties, structure and bonding of metal carbonyls and metal clusters
- To understand the role of metals in biological systems.

Syllabus

1. Chemistry of d and f block elements (6 hrs)

Transition Metals: General characteristics: Metallic character, oxidation states, size, density, melting points, boiling points, ionization energy, colour, magnetic properties, reducing properties, catalytic properties, complex formation and alloy formation. Difference between first row and other two rows.

Lanthanides: Electronic configuration and general characteristics

Isolation of lanthanides from monazite sand - Separation by ion exchange method. Lanthanide contraction: Causes and consequences.

Actinides: Electronic configuration and general characteristics – Comparison with lanthanides.

2. Coordination Chemistry (22 hrs)

Introduction - Types of ligands – Anionic, cationic and neutral – IUPAC Nomenclature - Structural and stereo isomerism in coordination compounds. Chelates and chelate effect- Stability of complexes: Factors influencing stability. Stepwise stability constant and overall stability constant.

Theories of bonding: Werner's theory, Sidgwick's concept of coordination, Valence bond theory - Geometries of coordination numbers 4 and 6 – Inner orbital and outer orbital complexes- Limitations of VBT. Crystal field theory - Splitting of *d*-orbitals in octahedral, tetrahedral - CFSE - low spin and high spin complexes. Spectrochemical series - Explanation of geometry, magnetism and spectral properties - Jahn Teller Effect– Splitting of *d*-orbitals in tetragonal and square planar complexes- Factors affecting crystal field splitting - Merits and demerits of Crystal field theory. Molecular orbital theory – evidence for metal ligand covalency- MO diagram for octahedral complexes (with sigma bonds only).

Spectral and magnetic properties of complexes – electronic absorption spectrum of $[Ti(H_2O)_6]^{3+}$. Calculation of magnetic moments – spin only formula.

Substitution reactions of metal complexes- Labile and inert complexes, ligand substitution reactions –S_N1 and S_N2 substitution reactions of square planar complexes – Trans effect and applications of trans effect.

Application of coordination chemistry in qualitative and quantitative analysis of metal ions such as Cu^{2+}, Zn^{2+}, $Ni^{2+}$and Mg^{2+}. Complexometric titrations and metal ion indicators

3. Organometallic Chemistry (9 hrs)

Definition, classification of organometallic compounds, Ylides, classification on the basis of hapticity, 18- electron rule-naming of organometallic compounds. Fluxional isomerism.

Metal-alkene complexes, Zeise's salt – preparation, properties and structure. Metal-alkyne complexes, carbene and carbyne complexes. Metallocenes – ferrocene (preparation and structure only).

Catalytic properties of organometallic compounds - alkene hydrogenation, Zeigler-Natta polymerization.

4. Metal carbonyls and clusters (8 hrs)

EAN rule. Preparation and properties of mononuclear carbonyls. - Structures of $Cr(CO)_6$, Fe $(CO)_5$ and $Ni(CO)_4$. Polynuclear carbonyls, bridged carbonyls. Bonding in carbonyls-$Mn_2(CO)_{10}$ and $Fe_2(CO)_9$.

Metal clusters – Classification. Low nuclearity carbonyl clusters (LNCCs)

Quadruple bond – structure of $Re_2CI_8^{2-}$. Halide clusters

Metal only clusters (Zintl ions).

5. Bio inorganic Chemistry (9 hrs)

Essential and trace elements in biological systems – Structure and functions of haemoglobin and myoglobin - Mechanism of oxygen transport, cooperativity, Bohr effect. Cytochromes, Vitamin B_{12}. Metalloenzymes- specificity and mechanism.

Role of alkali and alkaline earth metals in biological systems, Na/K pump. Importance of Ca and Mg. Metals in medicine- chelation therapy. Anti cancer drugs – cisplatin and carboplatin.

References

1. F.A. Cotton and G. Wilkinson, *Advanced Inorganic Chemistry*, 6th Edition, Wiley India Pvt. Ltd., New Delhi, 2009 (Reprint).
2. J.E. Huheey, E.A. Keitler and R.L. Keitler, *Inorganic Chemistry – Principles of Structure and Reactivity*, 4th Edition, Pearson Education, New Delhi, 2013.
3. D.F. Shriver and P. Atkins, *Inorganic Chemistry*, 5th Edition, Oxford University Press, New York, 2010.
4. B.R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, 33rd Edition, Milestone Publishers and Distributors, New Delhi, 2016-17.
5. Satya Prakash et.al, *Advanced Inorganic Chemistry, Volume 1 &2*, S. Chand and Sons, New Delhi, 19th edition.
6. J.D. Lee, *Concise Inorganic Chemistry*, 5th Edition, Oxford University Press, New Delhi 2010.

7. R. Gopalan and V. Ramalingam, *Concise Coordination Chemistry*, 1st Edition, Vikas Publishing House, New Delhi, 2001.
8. Wahid U. Malik, G D. Tuli and R.D. Madan, *Selected Topics in Inorganic Chemistry,* S. Chand and Co., New Delhi, 2010 (Reprint).

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**

Course Outcome

CO No :	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No :
1	Understandthe general characteristics of the d and f block elements	K2	1
2	Demonstrate various theories of bonding to explain the structure and properties of coordination compounds	K2, K3	1,3,4
3	Discuss the application of coordination chemistry in qualitative and quantitative analysis	K3	1,6
4	Identify the structure and bonding aspects of simple organometallic compounds	K4	1,2
5	Recognise the structure and properties of some metal carbonyls and clusters	K2, K5	1,2
6	Understand the role of metal ions in biological processes	K2, K4	1

7	Elucidate the structure and functions of some of biologically important inorganic transition metal complexes	K3, K5, K6	1,3
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

Semester **VI**	Code: **UG21CH6CR02**	**ORGANIC CHEMISTRY- IV**	Total Hrs:54	Credits:3

Course Objectives

Objectives

To enable the students-

- To have a thorough idea about heterocyclic compounds.
- To learn about Grignard reagents and synthetic reagents.
- To have an elementary idea of organic spectroscopy, photochemistry and pericyclic reactions.
- To identify organic compound using UV, IR and PMR spectroscopic techniques and elementary idea on green chemistry
- To give an outline of applied and advanced organic chemistry including medicinal chemistry polymer chemistry, green chemistry, supramolecular chemistry and dyes.

Syllabus

1. Organic compounds containing Nitrogen (9 Hrs)

Nitro compounds: -nitromethane- tautomerism- Reduction products of nitrobenzene in acidic, neutral and alkaline media- electrolytic reduction and selective reduction of poly nitro compounds- formation of charge transfer complexes.

Amines:- Isomerism- basicity of aliphatic and aromatic amines- Preparation- Gabriel-Phthalimide reaction, Hoffmann bromamide reaction-Reactions of amines - Separation and identification of a mixture of primary, secondary and tertiary amines- Quaternary ammonium salts.

Diazo compounds:- Diazonium salts :-Preparation, structure, synthetic applications of benzene diazonium chlorides, coupling reactions-Mechanisms of Sandmeyers and Gattermann reactions-Schiemann and Gomberg reactions -Diazomethane - preparation, structure and synthetic uses.

References

1. I. L. Finar Organic Chemistry -, 6th Edition. Vol.- I, Pearson. (Chapters- 13, 22, 23, 24)
2. R. T. Morrison and R.N Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India, (Chapter- 22,23,)
3. M. K.J ain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing
   Company Co. (Chapter-22)
4. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter- 22,23,24)
5. B. S. Bahl 'Advanced organic Chemistry', S. Chand.
6. Gupta, S.S. Organic Chemistry, Oxford University Press, 2014.

Further Reading

1. P. Y. Bruice, 'Organic Chemistry' - 3rdEdn. Pearson Education Asia.
2. John Mc Murry, 'Organic Chemistry' - Vth Edition -Thompson Asia Pvt Ltd
3. C. N. Pillai 'Organic Chemistry' Universities Press.
4. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press

2. Organic reagents (6 hrs)

Analytical reagents – Tollens reagent, Fehling solution, Schiff's reagents, Borsche's reagent, Benedict solution, Barford's reagent.

Synthetic reagents –NBS, Lead tetra acetate, Periodic acid, OsO_4 , Ozone, LDA, Raney Nickel, Ziegler –Natta Catalyst, Selenium dioxide, DCC (elementary idea)

Grignard and related compounds:- Grignard reagents-formation, structure and synthetic applications, alkyl lithium, Reformatsky reaction

References

1. A. I. Vogel, 'A Text Book of Practical Organic Chemistry', Longman.
2. F. G. Mann and B.C. Saunders, 'Practical Organic Chemistry', 4thedn. Pearson Education.

3. N. K. Vishnoi, 'Advanced Practical Organic Chemistry', Vikas Publishing House.
4. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-22)
5. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India.
6. I. L. Finar Organic Chemistry -, 6th Edition. Vol.- I, Pearson. (Chapter-15)
7. M.K.Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co.
8. K. S. Tewari and N. K. Vishnoi, 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-27)
9. B.S. Bahl 'Advanced organic Chemistry', S. Chand, 2010.
10. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, Wiley, 2014.
11. McMurry, J. Organic Chemistry, 7th ed. Cengage Learning, 2013.

Further reading

1. Paula Y. Bruice, 'Organic Chemistry' - 3rdEdn. Pearson Education Asia.
2. John Mc Murry, 'Organic Chemistry' - Vth Edition -Thompson Asia Pvt Ltd
3. C. N. Pillai 'Organic Chemistry' Universities Press.
4. J. March, 'Advanced Organic Chemistry', IVthEdn, John Wiley & Sons, NY
5. John Mc Murry, 'Organic Chemistry' - Vth Edition

3. Structure elucidation using spectral data (9 Hrs)

IR, UV and NMR spectral characteristics of simple molecules such as ethylene, butadiene, benzene, acetaldehyde, acetone, acetophenone, crotonaldehyde, ethanol, ethyl acetate, acetic acid, aniline and acetamide.

Problems pertaining to the structure elucidation of simple organic compounds using IR and PMR spectroscopic techniques

Mass spectrometry- Introduction- EI ionisation- Determination of Molecular mass by MS (elementary idea- fragmentation study not required)

References

1. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapter-17).
2. I. L. Finar Organic Chemistry, Vol.- I, 6th Edition, Pearson education (Chapter1).
3. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Vishal Publishing Company Co. (Chapter-44)
4. K. S. Tewari and N. K.Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House,(Chapter-26).
5. John R. Dyer: Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall.
6. R.M. Silverstein, G.C. Bassler& T.C. Morrill: Spectroscopic Identification of Organic Compounds, Wiley.

Further Reading

1. W. Kemp, 'Organic Spectroscopy', Longman, 1995.
2. D. L. Pavia, G. M. Lampman and G. S. Kriz' Introduction to Spectrosopy' Thomson Brooks Cole.
3. Paula Y. Bruice, 'Organic Chemistry', 3rdEdn. Pearson Education Asia

4. Applied Organic Chemistry (12 hrs)

Food additives: Artificial sweeteners- Saccharine, cyclamate- aspartame-Food flavours-esters-aldehydes and heterocyclic compounds-Food colours-Restricted use, spurious colours-Emulsifying agents – preservatives-leavening agents-baking powder-yeast-Taste enhancers-MSG-vinegar.

Soaps and Detergents:-Composition of soaps- detergent action of soap, TFM-Synthetic detergents – LAS and ABS detergent -comparison between soaps and detergents-Environmental aspects.

Introduction and classification. Polymerisation reactions - Addition and condensation - Preparation and applications of plastics – thermosetting (Phenol-formaldehyde, Urea-formaldehyde, Polyurethane) and thermosoftening (Polythene, PVC); Fibres (polyamide, polyester). Synthetic rubbers – SBR, Nitrile rubber and Neoprene.

Introduction to conducting polymers with examples. Environmental hazards and biodegradability of polymers. Recycling of plastics.

References

1. Billmeyer F.W., Text book of polymer science, Jr.John Wiley and Sons, 1994.
2. Gowariker V.R., Viswanathan N.V. and Jayader Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi

5. Medicinal Chemistry (6 hrs)

Medicinal chemistry:- Introduction, Elementary idea of the structure and mode of action of the following drugs:-Sulpha drugs-Sulphanilamide, Antibiotics-Ampicillin, Chloramphenicol, Antimalarial-Chloroquine, Analgesic -Paracetamol and Analgin. Drugs in cancer therapy- Chlorambucil.

References

1. I. L. Finar Organic Chemistry -, 6th Edition. Vol.- I, Pearson. (Chapter-18)
2. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-22)2010.
3. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-39)
4. R. T. Morrison and R.N Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India, (Chapter- 31)

Further Reading

1. B. S. Bahl 'Advanced organic Chemistry', S. Chand
2. John Mc Murry, 'Organic Chemistry', Vth Edition, Thompson Asia Pvt Ltd.
3. B. K. Sharma Polymer Chemistry, Goel Publishing House, Meerut, 1989.

6. Advanced Organic chemistry (12 Hrs)

Pericyclic reactions: -Classification- M.O approach (HOMO-LUMO)- Ethylene, Butadiene- electrocyclic, cycloaddition (Diels-Alder reaction) and sigmatropic reactions. Claisen rearrangement.

Photochemical reactions:-Introduction-Jablonski diagram. Fluorescence and phosphorescence, inter system crossing-Photo-Fries rearrangement.

Synthetic Dyes:-Theory of colour and constitution. Classification - according to structure and method of application. Preparation and uses of 1) Azo dye-methyl orange 2) Triphenyl methane dye -Malachite green 3) Phthalein dye -Phenolphthalein and Fluorescein 4) Vat dye - indigo 5) Anthraquinone dye -alizarin.

Supramolecular Chemistry:- Introduction-Molecular recognition-Host-guest interactions (elementary studies) types of non-covalent interactions.

References

1. P. Sykes, A Guide book to Mechanism in Organic Chemistry, 6th Edition, Orient Longman (Chapter-12 and p.198)
2. P.S. Kalsi' 'Organic Reactions and their Mechanisms'' New Age International Publishers (Chapter-17)
3. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', 3rd Edition, Vishal Publishing Company Co.(Chapter -47)
4. P. Y. Bruice, 'Organic Chemistry' - 3rdEdn. Pearson Education. (Chapter-28)
5. I. L. Finar Organic Chemistry -, 6th Edition. Vol.- I, Pearson. (P.-901-904).
6. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-22)
7. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-39)
8. Helena Dodzuik, Introduction to Supramolecular Chemistry, Springer Science Business Media, 2002
9. V.K. Ahluwalia, Green Chemistry, Narosa Publishing House, New Delhi, 2011.

Further Reading

1. R. Bruckner, 'Advanced Organic Chemistry' Elsevier
2. J. March, 'Advanced Organic Chemistry', IVthEdn, John Wiley & Sons, NY
3. S. H. Pine 'Organic Chemistry', McGraw Hill

4. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press
5. C. N. Pillai 'Organic Chemistry' Universities Press
6. J.M. Lehn Supramolecular Chemistry, VCH, 1995.
7. H.Vogtle Supramolecular Chemistry, John Wiley & Sons, Chichester 1993.
8. A.P. Dicks, Green Organic Chemistry in Lecture and Laboratory, CRC Press, University of Toronto, Ontario, Canada, 2011.

QUESTION PAPER PATTERN

Module	**Part A (Mark :1) Short Answer**	**Part B (Mark:5) Short Essay**	**Part C (Mark : 10) Long Essay**	**Total**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be Answered	**10**	**6**	**2**	**18**

Course Outcome

CO No :	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No :
1	State the reduction products of nitrobenzene in different conditions	K1	1
2	Discuss the preparation and properties of amines and diazo compounds	K1	1
3	Interpret the synthetic applications of organic reagents	K3	1,2,6
4	Describe and interpret the application of IR, UV and NMR and Mass spectrometry in structural determination of simple organic compounds	K2, K4	1,2,6
5	Recognize the role of organic chemistry in food and soap industry	K5	1,8

6	Explain the preparation and applications of plastics and synthetic rubbers	K2, K3	1,8
7	Discuss the structure and mode of action of sulpha drugs, antibiotics, analgesic and drugs in cancer therapy	K4, K5	1,2,8
8	Describe pericyclic reactions, photochemical reactions and supramolecular Chemistry	K2	1,2,3
9	Understand the theory of colours, structure, method of preparation and uses of important azo dye, triphenyl methane dye, phthalein dye, vat dye and anthraquinone dye	K2	1,6,8
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

Semester **VI**	Code: **UG21CH6CR03**	**PHYSICAL CHEMISTRY -III**	Total Hrs:36	Credits:2

Course Objectives

Objectives

- To study the laws of thermodynamics
- To derive Gibbs-Helmholtz, Clausius-Clapeyron, Gibbs-Duhem equations
- To derive the relation between Kp, Kc and Kx
- To derive the phase rule
- To derive the rate equations for zero, first and second order reactions
- To study the phase diagrams of one and two component systems
- To understand the theories of chemical kinetics
- To get an elementary idea of catalysis including enzyme catalysis.

Syllabus

1. Thermodynamics (36 hours)

Introduction, basic concepts – system, surroundings, types of systems, intensive and extensive properties, path and state functions, reversible and irreversible processes, exact and inexact differentials

Internal energy and enthalpy, work, First law of thermodynamics- mathematical statement, heat capacity, Cp and Cv relation in ideal gas systems, change in thermodynamic properties of an ideal gas during (i) isothermal/adiabatic, reversible/irreversible processes.

Joule-Thomson experiment, derivation of the expression for Joule-Thomson coefficient μ_{JT} , inversion temperature.

Zeroth law of thermodynamics, absolute temperature scale

Thermo chemistry: relation between heats of reaction at constant volume ad at constant pressure, enthalpies of formation, combustion, neutralization, solution and hydration, variation of enthalpy of a reaction with temperature- Kirchoff equation, Hess's law and its applications

Second law: Limitations of first law – statements of second law, Carnot's cycle – efficiency of heat engines, Carnot theorem. Entropy – definition and physical

significance, entropy change for various reversible/irreversible processes, spontaneous and non spontaneousprocesses .Change in entropy of an ideal gas with pressure, volume and temperature.

Third law of thermodynamics-statement and significance

Free energy functions– variation of Gibbs energy with T and P. Criteria for reversible and irreversible processes. Gibbs-Helmholtz equation. Clasius-Clapeyron equation, applications. Partial molar properties – chemical potential, Gibbs-Duhem equation, chemical potential in a system of ideal gases, concept of activity.

Chemical equilibrium: conditions for chemical equilibrium, relation between K_C and K_X – K_P ,van't Hoff reaction isotherm. Temperature dependence of K_P – van't Hoff equation.

References

1. R. P. Rastogi, R. R. Misra, An Introduction to Chemical Thermodynamics, 6th edn., Vikas Pub. Pvt. Ltd. (2003), chapters 1,2,3,4,5
2. P. Atkins and J Paula, The elements of Physical chemistry, 7thedn., Oxford University Press, Chapters 2,3,4,5
3. K. K. Sharma, L. K. Sharma,.A Textbook of Physical Chemistry, 4thedn,Vikas publishing House, Chapters 6,7, 8, 9
4. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co. Jalandhar, 46th Edition, 2013

Further reading

1. J. Rajaram and J. C. Kuriakose, Thermodynamics, Shoban Lal Nagin Chand & Co (1986).
2. H. Kuhn and H. D. Fosterling, Principles of Physical chemistry, John Wiley
3. W. J. Moore, Basic Physical Chemistry, Orient Longman.
4. D. A. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach Viva Books Pvt. Ltd
5. F. A. Alberty and R.J.Silbey, Physical Chemistry, John Wiley
6. G. M. Barrow, Physical Chemistry, 5thedn., Tata McGraw Hill
7. G. K. Vemulapalli, Physical Chemistry, Prentice-Hall of India Pvt. Ltd. (1997)
8. G. W. Castellan, Physical Chemistry, 3rd edn., Narosa Publishing House, New Delhi, (2004).

2. Phase equilibria (8 Hrs)

The phase rule (thermodynamic derivation), equilibrium between phases – conditions. One component system –water system, sulphur system. Two component systems – solid-liquid equilibrium – simple eutectic, lead- silver system, formation of compounds with congruent melting point ferric chloride- water system, formation of compounds with incongruent melting point sodium sulphate- water system.

R**eferences**

1. R. P. Rastogi, R. R. Misra, An Introduction to Chemical Thermodynamics, 6thedn., Vikas Pub. Pvt. Ltd. (2003), chapter 9
2. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 3, Macmillan India Ltd.3rd Edition, 2012
3. P. Atkins and J Paula, The elements of Physical chemistry, 7th edn., Oxford University

   Press, Chapter 8
4. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry,, Vishal Pub. Co. Jalandhar, 46th Edition, 2013

Further reading

1. W. J. Moore, Basic Physical Chemistry, Orient Longman.
2. D. A. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach Viva Books Pvt. Ltd
3. F A Alberty and R J Silby, Physical Chemistry, John Wiley
4. G. M. Barrow, Physical Chemistry, 5thedn., Tata McGraw Hill
5. G. K. Vemulapalli, Physical Chemistry, Prentice-Hall of India Pvt. Ltd. (1997)
6. G. W. Castellan, Physical Chemistry, 3rd edn., Narosa Publishing House, New Delhi, (2004).
7. H. Kuhn and H. D. Fosterling, Principles of Physical chemistry, John Wiley

3. Chemical Kinetics (10 Hrs)

Rate of reaction, rate equation, molecularity and order and of reactions, determination of order of the reactions, Integrated rate expressions for first and second order reactions. Zero order reactions, pseudo order reactions, half life.

Theories of chemical kinetics: effect of temperature on the rate of reaction, Arrhenius equation, concept of activation energy, Collision theory, transition state theory. Thermodynamic parameters for activation – Eyring equation (no derivation needed), enthalpy and entropy of activation.

Kinetics of chain reactions – steady state treatment, hydrogen bromine reaction. Complex (composite) reactions: Opposing reactions, consecutive reactions, and parallel (simultaneous) reactions (elementary idea only)

Catalysis: Homogeneous and Heterogeneous catalysis, Enzyme catalysis–Michaelis-Menten equation. Elementary idea about autocatalysis.

References

1. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co. Jalandhar, 46th Edition, 2013
2. D. A. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach Viva Books
   Pvt. Ltd Chapters 26, 27
3. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 4, Macmillan India Ltd,
   3rdEdition, 2012
4. K K Sharma, L K Sharma, A Textbook of Physical Chemistry, 4thedn, Vikas publishing
   House, Chapters 17, 18

Further reading

1. K. J. Laidler, Chemical kinetics 3rdedn, Pearson education 2004.
2. J Rajaram and J C Kuriakose, Kinetics and mechanisms of chemical transformations, Macmillan, 2006.
3. W. J. Moore, Basic Physical Chemistry, Orient Longman.
4. S. H. Marron and J. B. Lando, Fundamentals of Physical Chemistry, Macmillan Ltd. (1996)
5. F A Alberty and R J Silby, Physical Chemistry, John Wiley
6. G. M. Barrow, Physical Chemistry, 5thedn., Tata McGraw Hill
7. G. K. Vemulapalli, Physical Chemistry, Prentice-Hall of India Pvt. Ltd. (1997)
8. G. W. Castellan, Physical Chemistry, 3rdedn., Narosa Publishing House, New Delhi, (2004).

9. H. Kuhn and H. D. Fosterling, Principles of Physical chemistry, John Wiley

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be Answered	**10**	**6**	**2**	**18**

Course Outcome

CO No:	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No:
1	Analyse the thermodynamic properties in terms of extensive and intensive, state and path functions	K2	1,2
2	Relate internal energy, work, and heat change	K4	1,2
3	Explain Joule –Thomson effect		1,2
4	To acquire knowledge to derive Gibbs-Helmholtz, Clausius- Clapeyron, Gibbs-Duhem,van't Hoff Equation equations	K2	1,2,3,4
5	Construct Born-Haber cycle	K6	1,2,3,4
6	Investigate the spontaneity of a process	K4	1,2
7	Sketch the phase diagrams of one and two component systems	K3	1,2,4
8	Formulate the rate equations for zero, first and second order reactions	K6	1,2,4
9	Discuss the theories of reaction rates	K5	1,2,3,4
10	Explain the mechanism of catalysis	K3	1,2,4,6
Knowledge Levels: K1-Remembering; K2-Uunderstanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

Semester **VI**	Code: **UG21CH6CR04**	**PHYSICAL CHEMISTRY- IV**	Total Hrs:54	Credits:3

Course Objectives

Objectives

- To study the behaviour of binary liquid mixtures, CST, azeotropes, colligative properties
- To study solubility of gases in liquids,
- To study ionic equilibria, electrical and electromotive properties of ions in solution.
- To study the concepts of acids and bases, pH and buffer solutions

Syllabus

1. Solutions (12 hrs)

Introduction-- Binary liquid solutions – Raoult's law- ideal and non-ideal solutions- ΔGmix, ΔVmix, and ΔSmix for ideal solutions. Vapour pressure-composition and boiling point-composition curves of ideal and non-ideal binary liquid solutions. Fractional distillation of binary liquid-liquid solutions – distillation of immiscible liquids, partially miscible liquid-liquid systems. Critical solution temperature (CST) – the lever rule, introduction to ternary liquid solutions.

Solubility of gases in liquids – Henry's law. Distribution of a solute between two solvents – Nernst distribution law. Colligative properties of dilute solutions – vapour pressure lowering, Boiling point elevation and freezing point depression (thermodynamic derivation).Molar mass determination-related problems- Osmotic pressure –laws of osmotic pressure - Reverse osmosis – purification of sea water. Abnormal molecular masses – van' Hoff factor – degree of association and degree of dissociation.

References

1. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co. Jalandhar, 46th Edition, 2013
2. K. L. Kapoor, A Textbook of Physical chemistry, Volume 4, Macmillan India Ltd, 3rd Edition, 2012
3. *"Physical Chemistry",* K. J. Laidler and J. M. Meiser, 3rd Edition, Houghton Mifflin Comp., New York, International Edition (1999).

2. Ionic Equilibria (9 hours)

Introduction-concepts of acids and bases, relative strength of acid-base pairs, influence of solvents. Dissociation constants – acids, bases, and polyprotic acids. Ostwald's dilution law. Ionic product of water – pH. Buffer solutions – mechanism of buffer action, Henderson equation. Hydrolysis of salts – hydrolysis constant, degree of hydrolysis. Acid-base titrations- acid base indicators, theories, solubility product and common ion effect: principle – applications.

References

1. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 1, Macmillan India Ltd, 3rd Edition, 2012
2. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co.Jalandhar, 46th Edition, 2013

3. Electrical Conductance (12 Hours)

Introduction- Faraday's laws of electrolysis, electrochemical equivalent, electrolytic conductivity, molar conductivity - Variation of molar conductivity with concentration. Kohlrausch's law – applications.

Ionic mobility – relation with ion conductivity, influence of temperature on ion conductivity, ion conductivity and viscosity – Walden's rule. Abnormal ion conductivity of hydrogen and hydroxyl ions.

Discharge of ions during electrolysis – Hittorf's theoretical device. Transport Numbers – determination by Hittorf's method and moving boundary method.

Debye-Hückel theory of strong electrolytes – the concept of ionic atmosphere, Asymmetry and electrophoretic effect. Activity, mean ionic activity and mean ionic activity coefficients of electrolytes. Ionic strength of a solution, Debye-Hückel limiting law (no derivation). Applications of conductance measurements – Determinations of degree of dissociation of weak electrolytes, solubility of sparingly soluble salts, conductometric titrations.

References

1. K. L. Kapoor, A Textbook of Physical chemistry, Volume 1, Macmillan India Ltd, 3rd Edition, 2012
2. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co Jalandhar, 46th Edition, 201

4. **Electromotive Force (15 hrs)**

Introduction - Galvanic cells, characteristics of reversible cells. Reversible electrodes – different types, electrode potential – electrochemical series. Representation of cells – e.m.f of cell. Thermodynamics of reversible cells and reversible electrodes – Determination of ΔG, ΔH and ΔS of cell reaction. E.M.F and equilibrium constant of cell reaction, effect of electrolyte concentration on electrode potential and e.m.f (Nerst equation).

Concentration cells – electrode concentration cell and electrolyte concentration cells. Types of electrolyte concentration cells – with transference and without transference, liquid junction potential. Fuel cells – the hydrogen-oxygen fuel cell.

Applications of e.m.f measurements – determination of solubility product, determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode. Potentiometric titrations, Theory of redox indicators.

Irreversible electrode processes – overvoltage. Corrosion of metals – forms of corrosion, corrosion monitoring and prevention methods.

References

1. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 3, Macmillan India Ltd, 3rd Edition, 2012
2. I. N. Levine, Physical Chemistry, Tata Mc Graw Hill, 6th Edition, 2011
3. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry**,** Vishal Pub. Co. Jalandhar, 46th Edition, 2013

5. Group theory (6 hrs)

Elements of symmetry – Proper and improper axis of symmetry, plane of symmetry, centre of symmetry and identity element. Combination of symmetry elements, Schoenflies symbol, Point groups, C_2V, C_3V and D_3h, Group multiplication table of C_2V, Determination of point groups of simple molecules like H_2O, NH_3 and BF_3.

References

1. V Ramakrishnan and M S Gopinathan, *"Group Theory in Chemistry"*, Vishal Publishing.
2. G. K. Vemulapalli, *Physical Chemistry*, Prentice-Hall of India Pvt. Ltd. (1997)
3. L. H. Hall, Group Theory and Symmetry in Chemistry, McGraw Hill, 1969.
4. F. A. Alberty and R J Silby, Physical Chemistry, John Wiley, 4th Edition, 2004

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1. P. W. Atkins, The elements of Physical chemistry, 8th edn, Oxford University Press.
2. G. W. Castellan, Physical Chemistry, 3rd edn., Narosa Publishing House, New Delhi, (2004).
3. D. A. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach Viva Books Pvt. Ltd. (2005)
4. S. H. Marron and J. B. Lando, Fundamentals of Physical Chemistry, Macmillan Ltd. (1996)
5. H. Kuhn and H. D. Fosterling, Principles of Physical chemistry, John Wiley, 2nd Edition, 1993
6. W. J. Moore, Physical chemistry, Orient Longman, 4th Edition, 2012

QUESTION PAPER PATTERN

Module	Part A (Mark :1) Short Answer	Part B (Mark:5) Short Essay	Part C (Mark : 10) Long Essay	Total
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be Answered	**10**	**6**	**2**	**18**

Course Outcome

CO No :	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No:
1	Understand the behaviour of binary liquid mixtures	K2	1
2	Apply distillation techniques for separation of liquid- liquid systems	K2, K3	1,2
3	Solve problems based on colligative properties	K3	1,2,3,4
4	Explain the mechanism of Buffer action	K2, K3	1,2
5	Relate the variation of molar conductivity with concentration and apply Kohlrausch's law	K4	1,4

6	Determine transport numbers by Hittorf's method and moving boundary method	K2, K3	1,2,4
7	Derive Debye Huckel theory using the concept of ionic atmosphere	K3	1,2,4
8	Derive Debye Huckel theory using the concept of ionic atmosphere.	K2, K3	1,2,4
9	Connect the conductance measurements to determine the degree of dissociation of weak electrolytes	K3	1,2,4
10	Apply emf measurements in the determination of solubility product and pH.	K3	1,2,4
11	Construct character tables using symmetry, symmetry elements and point groups	K6	1,4
Knowledge Levels: K1-Remembering; K2-Uunderstanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Assessment Tools

Chalk and talk, Multimedia projection, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination

Semester **V &VI**	**UG21CH6CRP1**	**QUALITATIVE INORGANIC ANALYSIS**	Total Hrs: **(54 + 54 hrs**	Credits:3

Course Objectives

Objectives

1. Study reactions of radicals for their identification and confirmation.

2. Systematic qualitative analysis of mixtures containing two acid and two basic radicals.

Microscale analysis can be incorporated

1. Study of the reactions of the following radicals with a view to their identification and
confirmation.

Ag+, Hg^{2+}, Pb^{2+}, Cu^{2+}, Bi^{2+}, Cd^{2+}, As^{3+}, Sn^{2+}, Sb^{3+}, Fe^{2+}, Fe^{3+}, Al3+, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, Li^{+}, Na^{+}, K^{+}, NH^{4+}.

CO_3^{2-}, S^{2-}, $SO4^{2-}$, NO_3^{-}, F^{-}, Cl^{-}, Br^{-}, BO_2^{-}, $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, CH_3COO-, PO_4^{3-}, AsO_3^{3-}, AsO_4^{3-} and CrO_4^{2-}

2. Systematic qualitative analysis of mixtures containing two acid and two basic radicals from the above list without interfering radical by Semi-micro method only. *(Minimum of five mixtures to be analysed)*

References

1. A. I. Vogel 'A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis': (Third Ed.) (ELBS)
2. G. Svehla, Text Book of Vogel's Macro and Semi-micro Inorganic Analysis, revised, Orient Longman.
3. V. V. Ramanujam, 'Inorganic Semi micro Qualitative Analysis' ,The National Publishing
Co., Chennai.

1. Elimination of interfering anions such as F, BO_2^{-}, C_2O4_2-, $C_4H_4O_6^{2-}$, PO_4^{3-}, AsO_3^{3-}, $AsO_4^{3-}$and CrO_4^{2-}
2. Systematic qualitative analysis of mixtures containing two acid and two basic radicals from the following with one interfering radical by semi-micro method only

Ag^{+}, Hg^{2+}, Pb^{2+}, Cu^{2+}, Bi^{2+}, Cd^{2+}, As^{3+}, Sn^{2+}, Sb^{3+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, Li^{+}, Na^{+}, K^{+}, NH^{4+}.

CO_3^{2-}, S^{2-}, $SO4^{2-}$, NO_3^{-}, F^{-}, Cl^{-}, Br^{-}, BO_2^{-}, $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, CH_3COO-, PO_4^{3-}, AsO_3^{3-}, $AsO_4^{3-}$and CrO_4^{2-}

(Minimum of seven mixtures to be analysed)

References

1. G. Svehla 'Vogel's Qualitative Inorganic Analysis' Pearson Education
2. V. V. Ramanujam, 'Inorganic Semi micro–Qualitative Analysis', The National Publishing Co., Chennai

CO No :	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No :
1	Identify various ions present in a given inorganic sample	K3	1,6
2	Understand the principles of intergroup separation of cations	K2	1,6
3	Learn semi micro qualitative analysis for a mixture containing two acid and two basic radicals	K2, K3	1,6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Semester **V &VI**	**UG21CH6CRP2**	**PREPARATION AND BASIC LABORATORY SKILLS**	Total Hrs: **(36+ 36 hrs**	Credits:2

Course Objectives

Objectives

1**.** To study techniques like solvent extraction, crystallisation, distillation and chromatography.

2. Organic preparations

Preparation and Basic Laboratory skills

Microscale analysis can be incorporated

A. Basic Laboratory Skills

a. Solvent extraction – aniline from water - methyl benzoate from water - using ether- Record the yield recovery- (*Any two experiments shall be done*).

b. Crystallisation – Any four compounds using ethyl acetate, ethanol, and water - Record the yield recovery.

c. Distillation- Purification of water and ethyl acetate-Record the yield recovery.

d. Chromatography -

1. TLC - Separation and identification- Determination of Rf value of *o*-and *p*-nitroanilines - benzil and *o*-nitroaniline *ortho* and *para* chloroanilines or any two amino acids
2. Column Chromatography

B. Preparations

Organic preparations involving.-

1. Oxidation (benzaldehyde to benzoic acid).
2. Hydrolysis (methyl salicylate or ethyl benzoate to the acid).
3. Nitration (*m*-dinitrobenzene and picric acid).
4. Halogenation (*p*-bromoacetanilide from acetanilide).
5. Diazocoupling (methyl orange or benzene azo –β-naphthol
6. Acylation (Benzoylation of aniline, phenol, β -naphthol).
7. Esterification (benzoic acid)
8. Iodoform from acetone or ethyl methyl ketone.

9. Side chain oxidation (benzyl chloride to benzoic acid).
10. Claisen – Schmidt: Dibenzal acetone from benzaldyde.

C. Technique of quantitative dilution.

1. Preparation of 100 mL 0.2 M H_2SO_4 from commercial acid
2. Preparation of 250 mL 0.025 M thiosulphate from .1 M thiosulphate
3. Preparation of sucrose solutions of different concentrations by dilution

References

1. F. G Mann and B.C. Saunders, 'Practical Organic Chemistry' Fourth Edition, Pearson Education.
2. A.I.Vogel, 'Vogel's Textbook of Practical Organic Chemistry' Pearson Education
3. Brauer 'Handbook of Preparative Inorganic chemistry', Vol - I & II, Academic Press.

CO No:	Upon completion of this programme, the students will be able to	**Knowledge Level**	**PSO No:**
1	Develop basic skills in techniques of crystallisation, distillation and solvent extraction	**K6**	**1,6**
2	Learn the chromatographic techniques TLC and column chromatography	**K3**	**6**
3	Develop skill in organic preparations	**K6**	**6**
4	Familiarize the technique of quantitative dilution	**K2**	**6**
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Semester	**UG21CH6CRP3**	**PHYSICAL CHEMISTRY PRACTICALS**	Total Hrs: **54**	Credits:2

V &VI				

Objectives

1. To determine percentage composition of a mixture from Ostwald viscometer
2. To find heat of solution and heat of neutralization values
3. To find the concentration of a given strong acid from conductometric titrations.
4. To determine Transition temperature of salt hydrates.
5. To conduct critical solution temperature experiments and kinetic studies.
6. Data analysis of experiments using spreadsheet program

Microscale analysis can be incorporated

1. Viscosity – percentage composition of a mixture.
2. Heat of solution – KNO_3, NH_4Cl
3. Heat of neutralization
4. Determination of equivalent conductance of an electrolyte
5. Conductometric titration – strong acid *vs.* strong base, weak acid-strong base
6. Determination of partition coefficient of non-volatile solute between two immiscible solvents.

E.g. I_2 between CCl_4 and water.

7. Transition temperature of salt hydrates. (Sodium thiosulphate, sodium acetate)

References

1. W. G. Palmer: 'Experimental physical chemistry', Cambridge University Press.
2. J. B. Yadav: Advanced Practical Physical Chemistry Goel Publishing House.
3. R.C. Das and B. Behra; 'Experiments in Physical Chemistry', Tata McGraw hill.
4. K. K. Sharma : 'An Introduction of Practical Chemistry': Vikas Publishing House, New Delhi

Course Outcome:

CO	Upon completion of this programme, the	**Knowledge**	**PSO**

No:	students will be able to	**Level**	**No:**
1	Determine the composition of a mixture from viscosity measurements.	K3	1,4,6
2	Develop skills in calorimetric techniques to obtain heat of neutralization and heat of solution values	K3	1,4,6
3	Learn to find the transition temperature of salt hydrates.	K5	1,4,6
4	Investigate the effect of electrolytes on Critical Solution Temperature	K5	1,4,6
5	Determine the molecular mass of the solute by Rast method	K5	1.4,6
6	Predict the rate constant of ester hydrolysis	K5	1,2,3,4,6
7	Apply conductometric and potentiometric titrations to determine concentration of analytes	K3	1,2,3,3,6
8	Familiarize with spreadsheet programs.	K6	1,2,3,4,6
9	Determine the composition of a mixture from viscosity measurements	K5	1,2,3,4,6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Semester	**UG21CH6CRP3**	**PHYSICAL CHEMISTRY PRACTICALS**	Total Hrs: **54**	Credit:1

V &VI				

PHYSICAL CHEMISTRY PRACTICALS

Credit 1 **(54 hrs)**

1. Critical solution temperature. Phenol-water system
2. Determination of molecular weight by Rast's Method (using naphthalene, biphenyl as solvent and acetanilide, p-dichlorobenzene, biphenyl etc. as solute.)
3. Kinetics of simple reactions eg. Acid hydrolysis of methyl acetate.
4. Potentiometric titration – Fe^{2+} *vs.* $Cr_2O_7^{2-}$, I^- *vs.* MnO_4^-, strong acid- strong base, weak acid-strong base.
5. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant)
6. Determination of equivalence point of potentiometric and conductometric titrations using spreadsheet program.

References

1. W. G. Palmer: 'Experimental physical chemistry', Cambridge University Press.
2. J.B. Yadav: Advanced Practical Physical Chemistry Goel Publishing House.
3. R.C. Das and B. Behra; 'Experiments in Physical Chemistry' , Tata McGraw hill.
4. K.K. Sharma : 'An Introduction of Practical Chemistry': Vikas Publishing House, New Delhi
5.

Course Outcome:

CO No:	Upon completion of this programme, the students will be able to	**Knowledge Level**	**PSO No:**
1	Determine the composition of a mixture from viscosity measurements.	K3	1,4,6
2	Develop skills in calorimetric techniques to obtain heat of neutralization and heat of solution values	K3	1,4,6
3	Learn to find the transition temperature of salt hydrates.	K5	1,4,6

4	Investigate the effect of electrolytes on Critical Solution Temperature	K5	1,4,6
5	Determine the molecular mass of the solute by Rast method	K5	1.4,6
6	Predict the rate constant of ester hydrolysis	K5	1,2,3,4,6
7	Apply conductometric and potentiometric titrations to determine concentration of analytes	K3	1,2,3,3,6
8	Familiarize with spreadsheet programs.	K6	1,2,3,4,6
9	Determine the composition of a mixture from viscosity measurements	K5	1,2,3,4,6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

Semester	**UG21CH6CRP4**	**GRAVIMETRIC ANALYSIS**	Total Hrs: **(36+ 36 hrs**	Credits:2

V &VI				

1. Estimation of Barium as $BaSO_4$
2. Estimation of sulphate as $BaSO_4$
3. Estimation of magnesium as oxinate
4. Estimation of iron as Fe_2O_3
5. Estimation of Nickel as dimethyl glyoxime complex
6. Estimation of copper as CuCNS

References

1. A. I. Vogel 'A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis': (Third Ed.) (ELBS)

2. J. Bassett, R. C. Denney, G.H. Heffery and J Mendham, 'Vogel's Textbook of quantitative Inorganic Analysis' (revised), ELBS. 65

Course Outcome:

CO No:	Upon completion of this programme, the students will be able to	**Knowledge Level**	**PSO No:**
1	Quantitative analysis of substances through measurement of mass	**K4**	**3,6**
2	Demonstrate techniques like precipitation and filtration drying and incineration process	**K3**	**3,6**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UG project

Project & Industrial visit

UG21CH6PV

Course outcome

Students completing this course will be able to:

CO1. Acquire a knowledge in literature review.

CO2. Identify a research problem.

CO3. Obtain skills to characterise and interpret analytical tools.

CO4. Develop an interest in research activities.

CO5. Get expertise in doing novel experiments.

CO6. Extend industry academic - linkage.

CO7. Attain knowledge in data analysis and scientific writing.

CO No:	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No:
1	Acquire knowledge in literature review.	K2	1
2	Identify a research problem.	K2	1,6
3	Obtain skills to characterise and interpret analytical tools.	K4, K5	1,4,5,6
4	Develop an interest in research activities.	K6	1,6
5	Get expertise in doing novel experiments.	K3	1,2,6
6	Extend industry academic - linkage.	K4, K6	6
7	Attain knowledge in data analysis and scientific writing	K2, K3	1,6,7
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

UG21CH6CB : CHOICE BASED COURSES

Credits - 3 **(54 hours)**

(Students may be given the option to choose **any one** of the following courses)

UG21CH6CB07 : Nanochemistry and Nanotechnology

Aim:

The aim of this course is to provide a basic understanding of nanochemistry and nanotechnology.

Objectives:

To study

- History, terminology, and scales of nano systems
- Synthesis and characterisation of nano systems
- Electrical and optical properties of nano systems
- Applications of nanomaterials

1 History (12Hrs)

terminology- scales of nanosystems- nanoparticles : introduction-atoms to molecules-quantum dots-shrinking of bulk materials to quantum dots. Different types of nanoparticles: metal nanoparticles and monolayer substituted nanoparticles- fullerenes: synthesis and characterization- carbon nanotubes: synthesis and characterization-various approaches in nanoparticle synthesis : self-assembled monolayers, monolayer protected metal nanoparticles. -

2 Characterization of nanomaterials(15 Hrs)

Important methods for the characterization of nanomaterials – electron microscopy (SEM), transmission electron microscopy (TEM), scanning tunneling electron microscopy (STEM), environmental transmission electron microscopy (ETEM), scanning probe electron microscopy (SPL), secondary ion mass spectrometry (SIMS)-photoelectron spectroscopy (UPES and XPES).

3 Electrical and optical properties of nanomaterials (15 Hrs) electrical and optical properties of nanoparticles- electrical and optical properties of carbon nanotubes- nanocatalysis- nanolithography- nanochemical devices- optoelectronic devices- photodetectors- LEDs and lasers.

4 Applications of nanomaterials(12 Hrs) nanocrystals- immunogold labelling- applications in medical diagnosis- nanobased drug delivery- applications in biotechnology- nanosensors- self-assebly, nanosensor based on quantum size effects- nanobiosensors- nanomedicines- destructive applications of nanomaterials- nanomaterials in war**.**

References

1. T. Pradeep, Nano: The Essentials, Mc Graw Hill Publishing Company, New Delhi (2007).
2. V. S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009
3. C. N. R. Rao and A.Govindraj, Nanotubes and Nanowires, Royal Society of Chemistry (2005).
4. J. M. M. Duart, R. J. M. Palma and F.A. Rueda, Nanotechnology and microelectronics and optoelectronics, Elsevier (2002).
6. R. Booker and , E. Boysen, Nanotechnology, Wiley India Pvt Ltd, 2008
7. K. J. Klabunde, Nanoscale materials in chemistry, John Wiley and Sons.
8. C. P. Poole Jr and F J Owens, Introduction to nanotechnology, Wiley India Pvt Ltd 2009.
9. http://www.zyvex.com/nanotech/feynman.html.
10. G.LHornyak, J.Dutta, H.F Tibbals, A.K Rao, Introduction to Nanoscience, CRC Press

UG21CH6CB06 : INDUSTRIAL CHEMISTRY

Aim:

The aim of this course is to provide an outline of the application of the principles and techniques of chemistry in the manufacture some industrial products.

Objectives

- To understand the requirements to start an industry – different fuels used and the industrial catalysts used.
- To know about different petrochemical industries
- To understand the manufacture of fertilizers and speciality chemicals.
- To acquire knowledge about oils, soaps, detergents, sugar industry, leather and pesticide industries.
- To understand the important process of metallurgy, extraction of metals and environmental problems caused by chemical industries.

1. Industrial Requirements. (18 hours)

Requirements of an industry – location – water – industrial water treatment – safety measures – pilot plants. Fuels – types of fuels with examples – coal – carbonisation of coal – coal tar distillation – liquid fuels – gaseous fuels – selection of fuels – nuclear fuels. Energy – sources of energy – renewable and non-renewable energies – non conventional energies. Industrial catalysts – Types of catalysts – Functions and applications of Raney Nickel, Pd, $CuCrO_4$, TiO_2, Al, V and Pt based catalysts and zeolites

2. Petrochemical Industries (18 hours)

Crude oil - constitution and distillation - composition of different distillates - pour points, depressants, drag reducers, viscosity reducers, ignition point, flash point, octane number – cracking - catalysts used in petroleum industries - structure, selectivity and applications. Manufacture of synthetic petrol - Bergius and Fischer Tropsh processes - Manufacture of petrochemicals and petrochemical polymers - Manufacture of higher olefins, Acetaldehyde, Acetic acid, Ethylene glycol, Glycerine, Acetone, Phenol, Carbon disulphide, Vinylacetate, Cumene, Chlorophrene, Butane diols, Xylenes, Linear alkyl benzenes and their sulphonates.

3. Fertilizers and Speciality Chemicals (9 hours)

Manufacture - Properties and industrial uses of solvents - DMF, DMSO, THF and Dioxane. Fertilizers - Raw materials, manufacture (flow chart chemical process with

equations) of ammonium nitrate, ammonium sulphate, urea, calcium cyanamide, calcium ammonium nitrate, sodium nitrate, ammonium chloride, ammonium phosphate, super phosphate of lime, NPK fertilizers. Manufacture in pure form of the following - Sodium carbonate, Oxalic acid, Potassium dichromate, Perchloric acid.

4. Oils, Soaps and Detergents . (9 hours)

Manufacture of Cl2, NaOH and Chlorates of Na and K - manufacture of perchlorate. Oils - difference between oils and fats - manufacture of cotton seed oil and soybean oil - refining of oil -manufacture of soaps - toilet and transparent soaps - Detergents - synthetic detergents – surface active agents and their classification - manufacture of anionic, cationic and non ionic detergents and shampoo.
Sugar industry - manufacture of sugar from cane sugar and beet root.
Manufacture of leather - hides - Vegetable and chrome tanning finishing.
Manufacture of DDT, dinitrophenols, BHC, gamaxane, malathion, parathion

References:

1. Sharma B.K, Industrial chemistry, Goel publishing House, 2003, Meerut.
2. Drydens C.E, Outlines of Chemical Technology, Gopala Rao, Eastwest press, New Delhi.
3. Shreve R.V., Chemical Process Industries, Tata Mc Graw Hill publishing company, Mumbai.
4. Steines H., Introduction to Petrochemicals, Pergaman Press

UG21CH6CB01: POLYMER CHEMISTRY

1. Introduction and History of Polymeric Materials (4 Hrs)

History of Polymers. Terminology. Different schemes of classification of polymers. Polymer nomenclature.

2. Mechanisms of Polymerization (6 Hrs)

Classification of polymerization processes. Mechanism of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations. Mechanismof copolymerization. Mechanism of ring opening and group transfer polymerisations.

3. Polymerisation Techniques (4 Hrs)

Polymerisation techniques: Bulk, solution, suspension and emulsion polymerisations. Melt, solution and interfacial polycondensation techniques.

4. Physical Properties of Polymers (14 Hrs)

Structure-Property relationships of polymers.

Crystallization and Crystallinity: Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Molecular weight of polymers: Determination of Molecular Weight of Polymers (*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Glass Transition Temperature (Tg):Definition. Factors influencing glass transition temperature (Tg). Tg and molecular weight. Tg and melting point. Importance of Tg.

5. Reactions of Polymers (4 Hrs)

Hydrolysis, hydrogenation, addition, substitution, crosslinking, vulcanisation and cyclisation
reactions.

6. Polymer Degradation (4 Hrs)

Types of degradation. Thermal, mechanical, photo and oxidative degradations of polymers.

7. Polymer Processing (4 Hrs)

Polymer processing techniques: Compression moulding, Injection moulding, Blow moulding,
Extrusion moulding, Thermoforming, Die casting, Film casting, Rotational casting, Calendering.

8. Chemistry of Commercial Polymers (8 Hrs)

Brief introduction to the preparation, structure, properties and applications of the following polymers: polyolefins (LDPE, HDPE and PP), poly (vinyl chloride), polystyrene, poly (vinylacetate), acrylic polymers (PAN and PMMA), fluoro polymers (PTFE), aliphatic polyamides (Nylon 6,6 and Nylon 6), aromatic polyamides (Kevlar), polyesters (PET), formaldehyde resins (PF, UF and MF), polyurethanes, polycarbonates, epoxy resins.

9. Speciality Polymers (6 Hrs)

High temperature resistant and flame retardant polymers. Biomedical applications of polymers. Controlled drug delivery systems. Conducting polymers - polyacetylene, polyaniline, poly (p-phenylene sulphide), polypyrrole, polythiophene. Conduction mechanism and applications. Biodegradable polymers.

References

1. Carraher, C.E. Seymour/Carraher's Polymer Chemistry, 6th ed., Marcel Dekker, New York, 2003.
2. Odian, G. Principles of Polymerization, 4th ed., Wiley, 2004.
3. Billmeyer, F.W. Textbook of Polymer Science, 3rd ed., Wiley-Blackwell, 1984.
4. Gowariker, V.R., Viswanathan, N.V.; Sreedhar J. Polymer Science, 2nd ed., New Age, 2015.
5. Ghosh, P. Polymer Science & Technology, 2nd ed., Tata McGraw-Hill, New Delhi, 2002.
6. Lenz, R.W. Organic Chemistry of Synthetic High Polymers. Interscience Publishers, New York, 1967.
7. Bahadur, R., Sastry, N.V. Principles of Polymer Science, Narosa, New Delhi, 2003.

Visit to a polymer processing unit

UG21CH6CB05: SOIL AND AGRICULTURAL CHEMISTRY

Aim:

To study the fundamentals of soil and agricultural chemistry

Objectives:

- To understand the soil and its formation
- To know the physical properties of soil and other related aspects
- To acquire knowledge about chemistry aspects of soil and nitrogen fixing process
- To understand the chemistry of nutrients that are present in soil
- To understand the chemistry of pesticides, fungicides and herbicides

1. Origin of Soil . (9 Hrs)

Definition of soil - origin - igneous - metamorphic and sedimentary rocks - rock systems – weathering of rocks and minerals - main components of soil- organic, inorganic, liquid and gaseous phase - minerals of importance with respect to industries and agriculture - Soil formation - physical, chemical and biological factors responsible for soil formation-soil forming processes - Major soil groups of Kerala- methods of soil survey - remote sensing and soil mapping - soil resource management - use of satellite data for source inventory

2. Physical Properties of Soil (9 Hrs)

Physical properties of soil - soil texture and textural classification - pore space - bulk density, particle density - soil structure and soil colour - surface area - soil colloids - plasticity, shrinkage - flocculation and deflocculation - soil air, soil temperature, their importance in plant growth – soil reaction - Ion exchange reaction- cation exchange - anion exchange - Buffering capacity – hydrogen ion concentration - determination of pH values - Factors affecting soil pH - Soil pH and nutrient availability - Soil degradation - causes.

3. Chemistry Aspects of Soil (9Hrs)

Origin of problem soils, their properties- acid, alkali and saline soils - diagnosis - remediation of acid and salt affected soils - Methods of reclamation and after care - Quality of irrigation water – causes for poor quality waters for irrigation, their effects in soils and crops. Soil testing - concept, objectives and basis - soil sampling, collection processing, despatch of soil and water samples. soil organic matter - its decomposition and effect on soil fertility - source of organic matter in soil - maintenance and distribution - soil organism - their role - nitrification - denitrification, nitrogen fixation

in soils - biological nitrogen fixation - microbial interrelationship in soil - microbes in pest and disease management - Bio-conversion of agricultural wastes

4. Plant Nutrients (18 Hrs)

Plant nutrients - macro and micro nutrients - their role in plant growth - sources- forms of nutrient absorbed by plants - factors affecting nutrient absorption - deficiency symptoms in plants - corrective measures - chemicals used for correcting nutritional deficiencies - nutrient requirement of crops, their availability, fixation and release of nutrients. Fertilizers - classification of NPK fertilizers - sources - natural and synthetic - straight – complex - liquid fertilizers, their properties, use and relative efficiency - micro nutrient fertilizers - mixed fertilizers - principle of fertilizers use - the efficient use of various fertilizers - integrated nutrient management - biofertilizers - rhizobium, azospirillum, azetobacter - Blue green algae and azolla - production and quality control of bio-fertilizers.

5. Pesticides, Fungicides and Herbicides (9 Hrs)

Pesticides: Definition – Classification – organic and inorganic pesticides – mechanism of action – Characteristics – Safe handling of pesticides – impact of pesticides on soil, plants and environment – Acts and Laws concerning the pesticides. Fungicides: definition – classification – mechanism of action – sulfur, copper, mercury compounds, dithanes, dithiocarbamates. Herbicides: definition – classification – mechanism of action – Arsenic and boron compounds – nitro compounds, chloro compounds, triazines, propionic acid derivatives, urea compounds. Acaricides – rodenticides – attractants – repellants – fumigants, defoliants

References:

1. Biswas, T. D. and Mukeherjee, S. K. Textbook of Soil Science, 1987
2. Daji, A.J. A Textbook of Soil Science, Asia Publishing House, Madras, 1970
3. Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilizers, Macmillian Publishing Company, New York, 1990
4. Hesse,P.R. A Textbook of Soil Chemical Analysis, John Murray, New York, 1971.
5. Buchel, K.H. Chemistry of Pesticides, John Wiley & Sons, New York, 1983
6. SreeRamula, U. S. Chemistry of Insecticides and Fungicides, Oxford and IBH Publishing Co., New Delhi, 1979

Aim:

To provide a basic understanding of computational chemistry

Objectives

- To understand the use of computational chemistry as applied to modern problems in chemistry.
- To gain technical proficiency with computational chemistry software and to understand and make predictions about the properties of chemical systems through computation.
- To understand the role of cheminformatics and bioinformatics

1. **Computational Chemistry (22 Hrs)**

Introduction-Scope of computational chemistry-Computational tools-molecular mechanics- abinitio molecular orbital models- semiempirical molecular orbital models-Density Functional theory, -Introductory theory of these models- basis set-Slater and Gaussian functions-split-valence sets-selection of a suitable model for a computational problem

Molecular geometries-geometry optimization- potential energy surfaces, local and global minima, transition states, and Hessian indices-z-matrix of water, ammonia, methane, ethane, butane, ethene, and ethyne.

Constrained geometry optimization-single point energy calculation-conformational analysis of ethane and butane-constructing energy profile diagram,-determining inversion energy barrier of ammonia

Isodesmic and homodesmic reactions-comparing ring strain energy of cycloalkanes

Hands on experience on computational chemistry softwares- Huckel theory (SHMO free software www.chem.ucalgary.ca/**SHMO**/), Molecular mechanics (Tinker free software http://dasher.wustl.edu/) Semiempircal methods (Winmopac free software www.psu.ru/science/soft/**winmopac**/index_e.html) Abinitio methods (GAMESS free software www.classic.chem.msu.su/gran/gamess/downloads.html)

Programs for chemical structure drawing (ISISDRAW www.ch.cam.ac.uk/cil/SGTL/MDL/**ISISdraw**.html, Chemsketch www.acdlabs.com/download/)-

Software for visualization of computational results –molecular structure, molecular orbitals, dipole moments, electrostatic potentials- animations-dynamics- Molekel (free software www.cscs.ch/**molekel**/) Jmol (free software http://**jmol**.sourceforge.net/download/)

2. **Cheminformatics (16 Hrs)**

Introduction to cheminformatics, History and Evolution of cheminformatics, Use of cheminformatics, Prospects of cheminformatics, Molecular Modeling and Structure Elucidation

Nomenclature; Different types of Notations; SMILES Coding; Matrix Representations; Structure of Molfiles and Sdfiles; Libraries and toolkits; Different electronic effects; Reaction classification

Database Concepts, Structured Query Language, Design of Chemical Databases, Data Abstraction; Data Models (Elementary ideas only)

Prediction of Properties of Compounds; Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra;

Computer Assisted Structure elucidations; Computer Assisted Synthesis Design, Introduction to drug design; Application of Cheminformatics in Drug Design, Design of combinatorial libraries

3. **Bioinformatics (16 Hrs)**

Bioinformatics Basics- Internet Use and Search Engines- Fundamentals of Internet, WWW, HTML, URLs -Browsers: Netscape/Opera/Explorer Search Engines: Google, PUBMED, NCBI EMBL, GENBANK, Entrez, Unigene, PDB, SwissProt, And TrEMBL Bioinformatics Softwares and their uses (elementary ideas): Clustal V, Clustal W 1.7, RasMol, Oligo, Molscript, Treeview, Alscript, Genetic Analysis Software, Phylip

Introduction to Genes and Proteins- Genome Sequences ORFs, Genes, Intones, Exons, Splice Variants DNA/ RNA Secondary Structure, Triplet Coding Protein Sequences. Alignment of pairs of sequence ,Introduction to sequence analysis, Sequence analysis of biological data , models for sequence analysis and their biological motivation , methods of alignment, Application of dot matrix , Methods of optimal alignment using gap penalty and sore matrices, tools for sequence analysis

Introduction to phylogenetic tree analysis. Using pattern to predict genes, Method of gene prediction , prediction tools, protein structure databases and visualization tools, protein prediction tools, Method of protein prediction for known fold and unknown fold , protein function prediction.

Bioinformatics in pharmaceutical industries, immunology, agriculture, forestry,

Geoinformatics- Legal, ethical and commercial ramifications of bioinformatics, Biosensing

References

1. T Clark , Hand book of computational chemistry, Wiley New York.
2. W J Hehre, A J Shusterman, W W Huang, A laboratory book of computational organic chemistry , Wavefunction Inc.
3. A R Leach , Molecular Modeling, Longman
4. D C Young, Computational Chemistry ,A practical guide to applying techniques to real world problems, John Wiley

5. F Jensen , Introduction to computational chemistry , John Wiley
6. I Levine, Quantum Chemistry
7. Oprea, T. I. Chemoinformatics in drug discovery. John Wiley & Sons: New York, NY, 2005
8. Andrew Leach, An Introduction to Chemoinformatics Johann Gasteiger (Editor), Thomas Engel (Editor) Chemoinformatics: A Textbook Wiley Publications
9. Varnek, A., Tropsha, A, Eds.; Chemoinformatics Approaches to Virtual Screening; RSC Publishing, Cambridge, England, 2008.
10. H. M. Dietel, P. J. Dietel and T. R. Nieto, Internet and World Wide Web- how to program, Pearson Education India.
11. S.C. Rastogi, Namita Mendirata, Parag Rastogi ‘’Bioinformatics concepts, skills and application, CBS publisher
12. D. Baxevanis and F. Oulette, "Bioinformatics: A practical guide to the analysis of genes and proteins", Wiley (2002)
13. Arthur M. Lesk, "Introduction to Bioinformatics" Oxford University(2002), James Tisdall, Beginning Perl for Bioinformatics", O'Reilly & Associates., (200I) Learning Perl, 3rd Edition.
14. A Malcolm Campbell and L.J. Heyer ,Discovering Genomics proteomics and Bioinformatics

UG21CH6CB03: PHARMACEUTICAL CHEMISTRY

Objectives

- To understand the common diseases and the cure
- To know the terms of pharmacology
- To understand the mechanism of drug action
- To acquire knowledge about chemotherapy and the antibiotics
- To understand the drugs used for diabetes, hypertension, cholesterolemia
- To acquire knowledge about various health promoting drugs

1**. INTRODUCTION (18 Hrs)**

Common diseases - Infective diseases - insect-borne, air-borne and water-borne – hereditary diseases. Terminology - drug, pharmacology, pharmacognosy, pharmacodynamics, pharmacokinetics, anti metabolites. Absorption of drugs - routes of administration of drugs, factors affecting absorption. Assay of drugs - chemical, biological, immunological assays, LD_{50} and ED_{50} therapeutic index, drug dosage

2. DESIGNATION OF DRUGS (9 Hrs)

Designation of drugs based on physiological action; Definition and two examples with structure each of :Anesthetics-General and local. Analgesics - Narcotic and synthetic. Antipyretics and anti inflammatory agents. Antibiotics - penicillin, streptomycin, chloramphenicol, tetracyclins.
Antivirals. AIDS - symptoms, prevention, treatment. Cancer and neoplastic agents

3. COMMON BODY AILMENTS (9 Hrs)

Diabetes - Causes, hyper and hypoglycemic drugs -Psychedelic drugs, hypnotics, sedatives (barbiturates, LSD) - Blood pressure - Systolic & Diastolic Hypertensive drugs - Cardiovascular drugs – anti arrhythmic, antianginals, vasodilators – CNS depressants and stimulants – Lipid profile - HDL, LDL cholesterol, lipid lowering drugs.

4. HEALTH PROMOTING MEDICINES (18 Hrs)

Nutracenticals-Vitamins A B C D E and K (structure expected) micronutrients such as Na K Ca Cu Zn I -Medicinally important inorganic compounds of Al, P, As, Hg, Fe – Organic Pharmaceutical acids; Agents for kidney function(Aminohippuric acid); Agents for liver function (Sulfobromophthalein); Agents for pituitary function (metyrapone) - Organic pharmaceutical bases - antioxidants, treatment of ulcer and skin diseases

Book for Study:

1. Jayashree Ghosh, Pharmaceutical chemistry, S.Chand and Company Ltd., 2006, New Delhi.

Books for Reference:

1. Lakshmi S., Pharmaceutical chemistry, S.Chand& Sons, 1995, New Delhi.
2. Ashutosh Kar, Medicinal chemistry, Wiley Eastern Ltd., 1993, New Delhi.
3. David William & Thomas Lemke, Foyes principles of medicinal chemistry, 5thediton 2005, BI publishers.
4. RomasNogrady, Medicinal chemistry, II Edition 2004, Oxford University.

UG21CH6CB04: PETROCHEMICALS

1. Petrochemical Industries (30 hours)

Introduction to crude oil, explanatory methods, oil reservoirs, transportation of crude oil, constitution of crude oil, Natural gas – constituents. Distillation of crude oil, Separation of natural different fractions based on relative volatilities, Compositions of different distillates. Meaning of terms such as – Pour point depressants, drag reducers, viscosity reducers, ignition point, flash point, octane number, doctor solution. Types of hydrocarbon fuels and their characteristics. Detailed discussion of the following operations with respect to process, mechanism, catalysts used and applications; Cracking – catalytic cracking, Hydrocracking, Isomerization, Reforming, Alkylation. Sulphur, hydrogen, petroleum coke and nitrogen compounds from petroleum. General discussion of the following reactions with respect to mechanism and applications – Oxidation, ammoxidation, hydroformylation, hydrationgas – constituents

2. Manufacture of Petrochemicals (24 hours)

Manufacture of the following compounds: Methane, ethylene, acetylene, propylene, C – 4 hydrocarbons, higher olefins. Preparation of the following from methane – methanol, carbon black, hydrogen cyanide, chlorinated methanes, carbon disulphide. Preparation of the following from ethylene – Ethyl chloride, ethanol, ethylene oxide, ethylene glycol, acetaldehyde, acetic acid, styrene, vinyl acetate, ethanolamines, vinyl chloride, acrylonitrile. Manufacture of the following from propylene; Isopropanol, cumene, glycerine, acrylonitrile. Manufacture of the following from acetylene: Vinyl chloride, chloroprene, acrylonitrile, acetaldehyde. Manufacture of the following from C – 4 hydrocarbons: Butadiene, isobutene, isobutane, butanediols, oligomers.

References:-

1. W.L. Faith, Donald B Keyes, Ronald L Clark, Industrial Chemicals.
2. Speight G James, Marcel Dekker Inc 1991,The chemistry and technology of Petroleum
3. Tripathi G.N, Indian Petroleum Directory
4. B.K Sharma , Industrial Chemistry and Chemical Engineering, Spits Petrochemicals-Wiley
5. ASTM Methods, Indian standards
6. Sukumar Maiti, Introduction to Petrochemicals
7. Distillation of crude oil, Separation of natural gas and

UG21CH5OC: OPEN COURSES

Credits-3 (72 Hours)

UG21CH5OC02: Dairy Science

Aim: To study the fundamentals of dairy science

Objectives

- To understand the chemical composition of milk
- To know the techniques of milk processing
- To acquire knowledge about various milk products
- To understand the chemistry of other types of special milk
- To acquire knowledge about techniques of fermentation of milk and various milk products

1 Composition of Milk (12Hrs)

Milk - definition-general composition of milk - constituents of milk - lipids, proteins, carbohydrates ,vitamins and minerals - physical properties of milk - colour, odour, acidity, specific gravity, viscosity and conductivity - factors affecting the composition of milk - adulterants, preservatives and neutraliser-examples and their detection - estimation of fat, acidity and total solids in milk.

2 Processing of Milk (12Hrs)

Microbiology of milk - destruction of micro organisms in milk - physico - chemical changes taking place in milk due to processing - boiling, pasteurisation - types of pasteurisation - Bottle, Batch and HTST (High Temperature Short Time) - Vacuum pasteurisation - Ultra High Temperature Pasteurisation.

3 Major Milk Products (12Hrs)

Cream-definition-composition-chemistry of creaming process-gravitational and centrifugal methods of separation of cream-estimation of fat in cream.
Butter - definition - composition - theory of churning - desibutter - salted butter - estimation of acidity and moisture content in butter.
Ghee - major constitutents - common adulterants added to ghee and their detection - rancidity - definition - prevention - antioxidants and synergists - natural and synthetic.

4 Special Milk (12Hrs)

Standardised milk - definition - merits - reconstituted milk - definition - flow diagram of manufacture - Homogenised milk - flavoured milk - vitaminised milk - toned milk Incitation milk – vegetable toned milk - humanised milk - condensed milk - definition composition and nutritive value.

5 Fermented and Other Milk Products (24Hrs)

Fermented milk products - fermentation of milk - definition, conditions, cultured milk - definition of culture - examples, conditions - cultured cream - cultured butter milk - Bulgaxious milk - acidophilous milk - YoheerIndigeneous products - Khoa and chchana -definition - Preparation of khoa and chahana- sweets - Gulabjam, chana sweet, Rassogilla. Ice cream - definition - percentage composition types - ingredients - manufacture of ice-cream stabilizers - emulsifiers and their role- milk powder - definition - need for making milk powder - drying process - types of drying- dairy detergents - characteristics - classification - washing procedure - sterilization -chloramine T and hypochlorite solution.
Visit to a pasteurization factory/Milk product company and submission of a report.

References:

1. Robert Jenness and Patom S., Wiley, Principles of Dairy Chemistry, New York
2. Rangappa K.S. and Acharya K.T., Indian Dairy Products
3. Wond F.P., Fundamentals of Dairy Chemistry, Springer.
4. Lampert L.M., Modern Dairy products, Chemical Publishing Company Inc., New York.
5. Warner, Wiley, Principles of Dairy Processing, New York
6. Sukumar De, Outlines of Dairy technology.

UG21CH5OC03: FOOD SCIENCE

Aim:

To get a basic understanding of the different aspects of food science

Objectives

- To understand the chemistry of food adulteration and adulterants
- To know the methods of analyzing the adulterants
- To know the chemistry of food poisoning
- To acquire knowledge about food additives
- To understand the chemistry of beverages and soft drinks
- To know the methods of preparing the soft drinks by field visits
- To acquire knowledge about various edible oils and the processing techniques related to oils

1. Food Adulteration (18 Hrs)

Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, mlk, butter etc. with clay stones, water and toxic chemicals – Common adulterants. Ghee adulterants and their detection. Detection of adultered Foods by simple analytical techniques.

2. Food Poisons (9 Hrs)

Food poisons - natural poisons (alkaloids - nephrotoxic) - pesticides. (DDT, BHC, Malathion) - Chemical poisons - First aid for poison consumed victims.

3. Food Additives (18 Hrs)

Food additives - artificial sweeteners - Saccharin - Cyclamate and aspartate. Food flavours - esters, aldehydes and heterocyclic compounds. Food colours - restricted use - spurious colours – Emulsifying agents - preservatives ,leavening agents. Baking powder yeast - taste makers – MSG, vinegar.

4. Beverages (9 Hrs)

Beverages - Soft drinks - soda - fruit juices - alcoholic beverages examples. Carbonation – addiction to alcohol - cirrhosis of liver and social problems.

5. Edible Oils (18 Hrs)

Fats, oils - Sources of oils - Production of refined vegetable oils - Preservation. Saturated and unsaturated fatty acids – Iodine value - Role of MUFA and PUFA in

preventing heart diseases - determination of iodine - value , RM value, saponification value and their significance. Estimation of I2 and RM values in Edible oils

References:

1. Swaminathan M., Food Science and Experimental oods, Ganesh and Company.

2. Jayashree Ghosh, Fundamental concepts of Applied chemistry, S. Chand & Co. Publishers

3. Thankamma Jacob, Text Books of applied chemistry for Home Science and allied Sciences,

Macmillan.

4. B. Sreelakshmi, Food Science, New Age

UG21CH5OC04: Forensic Science

Aim: To study some fundamental aspects of forensic science

Objectives

- To learn Crime investigation through diagnosis of poisoning and postmortem.
- To acquire knowledge about explosions, the causes (gelatin sticks, RDX etc) and the security measures.
- To understand the methods of detecting forgery in bank and educational records.
- To acquire a comprehensive knowledge about tracks and traces.
- To understand the chemical methods used in crime investigation. (Medical aspects).

1. Poisons (12 Hrs)

Poisons-types and classification-diagnosis of poisons in the living and the dead – clinical symptoms - postmortem appearances. Heavy metal contamination (Hg, Pb, Cd) of sea foods-use of neutron activation analysis in detecting Arsenic in human hair. Treatment in cases of poisoning - use of antidotes for common poisons.

2. Crime Detection (12 Hrs)

Accidental explosion during manufacture of matches and fire works. Human bombs-possible explosives (gelatin sticks and RDX) - metal detector devices and other security measures for VVIP- composition of bullets and detecting powder burn. Analysis of incendiary and timed bombs - spill of toxic and corrosive chemicals from tankers.

3. Forgery and Counterfeiting (12 Hrs)

Documents - different types of forged signatures-simulated and traced forgeries - inherent signs of forgery methods - writing deliberately modified- uses of ultraviolet rays - comparison of type written letters - checking silver line water mark in currency notes - alloy analysis using AAS to detect counterfeit coins - detection of gold purity in 22 carat ornaments - detecting gold plated jewels - authenticity of diamond.

4. Tracks and Traces (18 Hrs)

Tracks and traces - small tracks and police dogs-foot prints - casting of foot prints - residue prints, walking pattern or tyre marks - miscellaneous traces and tracks - glass fracture - tool mark paints – fibres. Analysis of biological substances - blood, saliva, urine and hair- Cranial analysis (head and teeth) DNA Finger printing for tissue identification in dismembered bodies -Detecting steroid consumption in athletes and race horses.

5. Medical Aspect (18 Hrs)

Aids - causes and prevention - misuse of scheduled drugs - burns and their treatment by plastic surgery. Metabolite analysis using mass spectrum – gas chromatography. Arson-natural fires and arson - burning characteristics and chemistry of combustible materials - nature of combustion. Ballistics - classification - internal and terminal ballistics - small arms - laboratory examination of barrel washing and detection of powder residue by chemical tests.

References:

1. T. H. James, Forensic Sciences, Stanley Thornes Ltd.
2. Richard, Criminalistics - An Introduction to Forensic Science (College Version), 8th Edition, Sofestein, Printice Hall.

UG21CH5OC01:- CHEMISTRY IN EVERYDAY LIFE

1. Food Additives (12 Hrs)

Food additives – definition. Preservatives, Food colours - permitted and non-permitted, Toxicology. Flavours - natural and synthetic. Artificial sweeteners, Emulsifying agents, Antioxidants, Leavening agents and Flavour enhancers. Importance of food additives. Soft drinks - formulation and health effects. Health drinks. Fast foods and junk foods and their health effects. Food adulteration. Food laws and standards. Food Safety and Standards Act, 2006.

2. Soaps and Detergents (10 Hrs)

Soaps – Introduction. Types of soaps - Toilet soaps, washing soaps. Liquid soap. TFM and grades of soaps. Bathing bars. Cleansing action of soap. Detergents - Introduction. Types of detergents - anionic, cationic, non-ionic and amphoteric detergents. Common detergent additives. Enzymes used in commercial detergents. Comparison between soaps and detergents. Environmental aspects.

3. Cosmetics (10 Hrs)

Cosmetics - Introduction. General formulation of different types of cosmetics – Dental cosmetics, Shampoos, Hair dyes, Skin products (creams and lotions, lipstick, perfumes, deodorants and antiperspirants), Bath oil, Shaving cream and Talcum powder. Toxicology of cosmetics.

4. Plastics, Paper and Dyes (12 Hrs)

Plastics in everyday life. Plastics and Polymers. Classification of polymers. Brief idea of polymerization. Use of LDPE, HDPE, PP, PVC and PS. Environmental hazards of plastics. Biodegradable plastics. Recycling of plastics. Paper – Introduction. Paper manufacture (basicidea only). Weight and size of paper. Types of paper - News print paper, writing paper,paperboards, cardboards. Environmental impact of paper. International recycling codes, andsymbols for identification of plastics. Natural and synthetic dyes with examples (elementaryidea only).

5. Drugs (9 Hrs)

Classification of drugs - Analgesics, Antipyretics, Antihistamines, Antacids, Antibiotics and Antifertility drugs with examples. Psychotropic drugs - Tranquilizers, Antidepressants and Stimulants with examples. Drug addiction and abuse. Prevention and treatment.

6. Chemistry and Agriculture (12 Hrs)

Fertilizers – Introduction. Types of fertilizers - Natural, synthetic, mixed, NPK fertilizers. Excessive use of fertilizers and its impact on the environment. Bio-fertilizers. Plant growth hormones. Pesticides - Introduction. Classification - Insecticides, Fungicides, Herbicides. Excessive use of pesticides - Environmental hazards. Bio pesticides.

7. Nanomaterials (7 Hrs)

Terminology. Scales of nanosystems. Different types of nanoparticles. Applications of nanoparticles in biology and medicine – biological labels, drug and gene delivery, tissue engineering, tumour destruction. Other applications of nanoparticles – electronics, paints, food packaging. Toxicology of nanoparticles.

References:

1. B. Sreelakshmi, *Food Science*, New Age International, New Delhi, 2015.
2. Shashi Chowla; *Engineering Chemistry*, Danpat Rai Publication.
3. B.K. Sharma; *Industrial Chemistry*. Goel Publishing House, Meerut, 2003.
4. C.N.R. Rao; *Understanding Chemistry*, Universities Press.
5. M.K. Jain and S.C. Sharma; *Modern Organic Chemistry*, Vishal Pub. Co., Jalandhar, 2009.
6. A.K. De; *Environmental Chemistry*, New Age International Ltd., New Delhi, 2006.
7. S.S. Dara; *A Textbook of Environmental Chemistry and Pollution Control*, S. Chand & Company Ltd.
8. J.W. Hill; T.W. McCreary and D.K. Kolb; *Chemistry for Changing Times*, Prentice Hall, 12thedn., 2010.
9. V. R. Gowariker; N.V. Viswanathan and J. Sreedhar*; Polymer Science*, 2ndedn., New Age, New Delhi, 2015.
10. D. Sriram and P. Yogeeswari; *Medicinal Chemistry*, 2ndedn. Pearson, 2011.
11. S.L. Tisdale; W. L. Nelson and J. D. Beaton; *Soil Fertility and Fertilizers*, Macmillan Publishing Company, New York, 1990.
12. K. H. Buchel; *Chemistry of Pesticides*, John Wiley & Sons, New York, 1983.
13. P.C. Pall; K. Goel and R.K. Gupta*; Insecticides, Pesticides and Argobased Industries.*
14. T. Pradeep; *Nano- The Essentials*, McGraw Hill Publishing Co., New Delhi, 2007.
15. V. S. Muraleedharan, A. Subramania*; Nanoscience and Nanotechnology*, Ane Books, New Delhi, 2009.
16. K.J. Klabunde; *Nanoscale Materials in Chemistry*, Wiley.

UG21CH5OC05: Nanoscience and Nanotechnology

Aim:

To study the fundamentals of nanoscience and nanotechnology

Objectives

- Why Nanotechnology?
- What are the historical landmarks in the area?
- What are the terms and concepts of Nanoscience?
- What are nanoparticles, nanotubes, nanowires and other low-dimensional systems?
- What are the principal properties used to explore nanomaterials and what are the techniques used?
- How do we manipulate nanomaterials in areas such as biology, biotechnology, medicine, medical diagnosis, sensors etc.?
- What are the main social, economic and ethical issues related to Nanotechnology?

1. Nanomaterials (18 Hrs)

Historical landmarks- terminology-scales-top-down and bottom-up paths in nanoscience- Feynman's hypothesis-low dimensional solids-nanoparticles: fullerene-its discovery-production-contribution to nanotechnology-unusual properties of fullerene. Nanotubes:carbon nanotubes- architectural characteristics- synthesis-properties.

2. Nanoscience: (18 Hrs)

Its social, economic and ethical perspectives- responsible development of nanotechnology- existing laws and regulations- regulatory agencies-U.S. Govermment laws- intellectual property policy of nanotechnology- technology transfer. Energy challenges-environmental impacts of nanotechnology- Green nanotechnology-technology business: nanoeconomics- entrepreneurs in the technological ecosystem-nanoethics- challenges to mankind- future of nanotechnology.

3. Seeing the nanoworld (18 Hrs)

fundamental particles-elctromagnetic radiation- its components- impact on matter-the Planck's equation- de Broglie relation- matter-wave concept of radiation- concept of colour and vision- spectroscopic methods and radiation- elementary ideas of UV-visible, IR, NMR,XPES and UPES techniques. X ray techniques- SEM, TEM, STM, SPL, and SIMS - their use in the studies of nanosystems.

4. Applications of nanotechnology (18 Hrs)

Nanobiology- immuno targeted nanoparticles-nanomaterials in medical diagnosis- bio-nano information fusion. Nanomedicines- nanoparticle drug systems for oral, nasal, and ocular administration- therapeutic applications. Nanosensors- smart dusts-nanomaterials in war- destructive applications of nanotechnology.

References

1. T. Pradeep, Nano: The Essentials, Mc Graw Hill Publishing Company, New Delhi (2007).
2. V. S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009
3. C. N. R. Rao and A.Govindraj, Nanotubes and Nanowires, Royal Society of Chemistry (2005)
4. J. M. M. Duart, R. J. M. Palma and F.A. Rueda, Nanotechnology and Microelectronics and optoelectronics, Elsevier (2002)
5. R. Booker and , E. Boysen, Nanotechnology, Wiley India Pvt Ltd, 2008
6. K. J. Klabunde, Nanoscale materials in chemistry, John Wiley and Sons.
7. C. P. Poole Jr and F J Owens, Introduction to nanotechnology, Wiley India Pvt Ltd 2009.
8. L. E. Foster, Nanotechnology: Science, Innovation and Opportunity, Pearson Education (2008).
9. http://www.zyvex.com/nanotech/feynman.html

Chemistry Resources on the Internet

ISIS Draw, Free Chemical structure drawing program

http://www.cem.msu.edu/~reusch/vtxtindex.htm An excellent virtual text book of organic chemistry

http://www.chem1.com/acad/webtext/virtualtextbook.html

www.symmetry.otterbein.edu/tutorial/index.html symmetry topics with interactive models

http://www.chem.ucalgary.ca/courses/351/Carey5th/Carey.html online organic chemistry book

http://molinspiration.com:9080/mi/webme.html molecule sketcher allows creation and editing of molecules online

http://hyperphysics.phy-astr.gsu.edu/hbase/HFrame.html website with extensive hyperlinking to explore topics in thermodynamics, kinetic molecular theory, quantum mechanics and physics in general

http://www.webelements.com/webelements/scholar/index.html periodic table

http://www.chemeddl.org/collections/ptl/ periodic table

http://www.rsc.org/chemsoc/visualelements/PAGES/pertable_fla.htm periodic table

www.chemtube3d.com/ This site contains interactive 3D animations for some of the most important organic reactions

COMPLEMENTARY COURSES IN CHEMISTRY

SEMESTER - I

UG21CH1CM01: Basic Theoretical and Analytical Chemistry (Common to Physical Sciences and Life Sciences)

Credits - 2 **(36 Hrs)**

Aim:

The ai

m of the course is to provide an insight into some of the fundamental concepts and principles that are very essential in the study of chemistry for theory and practicals.

Objectives:

- To study atomic structure and the principles governing the electronic configuration of atoms
- To study various types of chemical bonding
- To understand the basics of thermodynamics and the concept of equilibrium
- To familiarise with the basic principles of analytical chemistry

1. Atomic Structure (6 Hrs)

Introduction:- Atoms, Dual nature of matter and radiation. Photoelectric effect, de Broglie equation, Heisenberg's uncertainty principle, Concept of orbital, Quantum numbers, shapes of orbitals (s-, p-, d-), Electronic configuration of atoms-Aufbau principle, Hund's rule of maximum multiplicity, Pauli's exclusion principle.

References:

1. ManasChanda, Atomic Structure and Molecular Spectroscopy
2. P. L. Soni Inorganic Chemistry
3. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3rd edn. Vishal Pub. CO., 2008 (Chapter 19)
4. C. N. R. Rao, University General Chemistry, Macmillan (Chapter 3)

2. Chemical Bonding (8 Hrs)

Chemical bonding; Introduction – Types of bonds. Ionic bond; Factors favouring the formation of ionic bond. Covalent bond; Valence Bond Theory – Coordinate bond. VSEPR theory and examples. Hybradisation – sp (BeF_2), sp^2 (BF_3), sp^3 (CH_4).

Molecular Orbital Theory (Elementary Idea); LCAO – Electronic configuration of N_2, O_2 –Calculation of Bond order –Explanation of bond length and bond strength. Intermolecular forces- Hydrogen bonding in water – Dipole-Dipole interactions**.**

References

1. Manas Chanda, Atomic Structure and Molecular Spectroscopy
2. P. L. Soni Inorganic Chemistry
3. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3rd edn. Vishal Pub. CO., 2008 (Chapter 19)
4. C. N. R. Rao, University General Chemistry, Macmillan (Chapter 3)

3. Thermodynamics (8 Hrs)

System and Surrounding. Internal energy, Significance of internal energy change, enthalpy, First law of Thermodynamics- mathematical statement. Second law of Thermodynamics: free energy, Entropy and Spontaneity, Statement of second law based on entropy, Entropy change in Phase transitions (No derivation required)-entropy of fusion, entropy of vaporization, entropy of sublimation.

The concept of Gibbs's free energy- Physical significance of free energy, conditions for equilibrium & spontaneity based on ΔG values. Effect of temperature on spontaneity of Reaction. Third law of Thermodynamics.

Thermodynamics of Living cell- Exergonic and endergonic reactions, coupled reactions.

References

1. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3rd edn. Vishal Pub. CO., 2008 (Chapter 9,11,12)
2. C. N. R. Rao, University General Chemistry, Macmillan (Chapter 9)

4. Acids and Bases (7 Hrs)

Acids and bases –Arrhenius, Lowry-Bronsted and Lewis Concepts, ionic product of water, introductory idea of pH, pOH. Strengths of acids and bases, Ka and Kb, pKa and pKb, Buffer solutions (elementary idea), solvation, solubility, solubility product, common ion effect, application.

References

1. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3rd edn. Vishal Pub. CO., 2008 (Chapter 16)
2. C. N. R. Rao, University General Chemistry, Macmillan (Chapter 11)

5. Analytical Chemistry (7 Hrs)

Methods of expressing Concentration - molality, molarity, normality, weight percentage, ppm, and millimoles.

Theory of volumetric analysis -Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions, end point.

Acid-base titrations, redox titrations and complexometric titrations and corresponding indicators (general idea only). Double burette method of Titration, Micro analysis and its Advantages. Reporting analytical data; Units, significant digits, rounding, scientific and prefix notation, graphing of data- Precission and accuracy-Types of errors – ways of expressing precision – methods to reduce systematic errors

Water Quality Parametres – BOD, COD, DO, TDS, Hardness, pH (Elementary idea) Specification for potable water.

References

1. R. A. Day Junior, A.L. Underwood, Quantitative Analysis, 5thedn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988 (Chapters 2, 3, 4, 6, 8, 11)
2. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, 6thedn. Pearson Education (2003) (Chapters 3, 4, 10)
3. R. Gopalan, Analytical Chemistry, S. Chand and Co., New Delhi

CO No:	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No:
1	Understand the dual nature of matter and the concept of orbitals	K2, K4	1
2	Apply the various principles to write the electronic configuration of atoms	K1, K2, K3	1,2
3	Explain the different types of bonding between atoms	K2	1,2,3,4

4	Apply Molecular orbital theory to determine the bond order and bond strength of molecules	K2, K3	1,2
5	Explain the significance of terms in thermodynamics like internal energy, entropy and enthalpy	K4, K5	1,3,4
6	Understand the laws of thermodynamics and the conditions for equilibrium and spontaneity	K1, K2	1,2,3,4
7	Familiarise the thermodynamics of living cells and coupled reactions	K2, K6	1,2,4
8	Explain the strength of acids and bases and the application of solubility product principle and common ion effect	K2, K3, K4	1,2,4
9	Understand the basic principles and concepts in analytical chemistry	K2, K3, K4	1,2,3,4
10	Compare the different types of titration techniques	K2. K4, K5	1,2,4
11	List out the advantages of micro analysis	K4, K6	1,2,4
12	Analyse the water quality parameters	K4	1,4
Knowledge Levels: K1-Remembering; K2-Uunderstanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

SEMESTER-II

UG21CH2CM01: Organic and Nuclear Chemistry
(Common to Physical Sciences and Life Sciences)

Credits -2 **(36 Hrs)**

Aim:

The aim of the course is to understand fundamental aspects of organic chemistry and polymers.

Objectives:

To study

- Mechanism of some basic organic reactions.
- Classification of polymers, polymerization reactions and the structure and uses of some commercial and natural polymers
- Chromatographic techniques and nuclear chemistry

1. Organic Reaction mechanism (10 Hrs)

Electron displacement Effects - Inductive, mesomeric, and hyperconjugative effects. Bond fission- homolytic and heterolytic fission. Reaction intermediates- radicals, carbocations and carbanions.

Classification of reagents- electrophiles, nucleophiles. Types of organic reactions – addition, substitution and elimination reactions.

Substitution reactions: nucleophilic substitution of alkyl halides- SN1 and SN2 mechanisms. Electrophilic substitution in benzene-reaction mechanism.

Addition reactions: electrophilic addition to ethene, propene and ethyne-the Markwonikoff's rule, Peroxide effect.
Elimination reactions: E1 and E2 mechanisms

References

1. I. L. Finar, Organic Chemistry, 6thedn. Vol. I Pearson (Chapters 2, 4, 5, 20)
2. Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, 6thedn. Orient Longman, 1988 (Chapters 4, 7, 9)
3. S. M. Mukherji, S.P Singh, Reaction Mechanism in Organic Chemistry, Macmillan, Third Edn.,2003 (Chapters 1, 2, 4, 5, 6, 9)

2. Separation and Purification of Organic Compounds (8 Hrs)

Separation and purification techniques; Recrystallisation, Use of drying agents, Sublimation. General principles of distillation, fractional distillation, distillation under reduced pressure, Solvent Extraction

Basic principle and uses of Thin layer chromatography (TLC), Paper chromatography (PC), Rf value, Column chromatography, Gas chromatography (GC), High performance Liquid chromatography (HPLC), Ion Exchange chromatography (IEC).

References

1. R. A. Day Junior, A.L. Underwood, Quantitative Analysis, 5thedn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988 (Chapters17, 18)
2. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denny, J. D. Barnes, M. Thomas, 6thedn. Pearson Education (2003).
3. R. Gopalan, Analytical Chemistry, S. Chand and Co., New Delhi.

3. Nuclear Chemistry (8 Hrs)

Nuclear Processes: natural radioactivity, induced radioactivity, Radioactivity-detection, units of radioactivity. Modes of decay- Group displacement law. Isotopes, isobars and isotones with examples. Nuclear fission-Atom Bomb -Nuclear fusion-Hydrogen Bomb-Nuclear reactors- Nuclear reactors in India. Application of radio isotopes – Carbon dating-Rock dating-Isotopes as tracers –Radiodiagonosis and radiotherapy

References

1. H J Arnikar , Essentials of Nuclear chemistry(Revised IVthedn.), New Age, 1995
2. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3rdedn. Vishal Pub. CO., 2008 (Chapter 16)

4. Natural and Synthetic Polymers (10 Hrs)

Classification of polymers; Natural, Synthetic; linear, cross linked and network, plastics, elastomers, fibers; homopolymers and copolymers. Polymerisation reactions, typical examples-polyethylene, polypropylene, PVC, Phenol-Formaldehyde resin, Polyamides (Nylon 6 6), and polyester. Natural rubber; structure, vulcanization. Synthetic rubbers-SBR, Nitrile rubber, neoprene. Glass transition temperature-definition. Engineering plastics, conducting polymers, Environmental hazards of polymers**.**

References

1. V R Gowrikar, Polymer Chemistry, New Age International Pvt.Ltd. New Delhi, 2010
2. Fred W Billmeyer, Jr., Textbook of Polymer Science, A Wiley-Interscience Publication

CO No:	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No:
1	Understand the Electron displacement Effects	K2, K4	1,2
2	Explain the mechanism of some basic organic reactions.	K2, K3, K6	1,2,3
3	Apply chromatographic techniques for the separation and purification of organic compounds	K2, K3	1,2,3,4,6,8
4	Distinguish between nuclear fission and nuclear fusion	K1, K4	1,2,3
5	Analyse the modes of radioactive decay and application of radioactive isotopes	K1, K4, K5	1,2,3,4
6	Classify the polymers based on their origin, structure and properties	K1, K2	1,3
7	Explain the different methods of polymerisation	K2, K4	1,2,6
7	Evaluate the applications and environmental hazards of polymers	K4, K5	1,2,3,8
Knowledge Levels: K1-Remembering; K2-Uunderstanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

SEMESTER - III
UG21CH3CM01: Physical Chemistry – I
(For students who have opted Physical Sciences as Main)

Credits-3 **(54 Hrs)**

Aim:

To give the students a thorough knowledge about molecular structure and its electrical and nuclear properties and to develop proper aptitude towards the study of molecular structure

Objectives:

- To enable the students to get a clear idea about the molecular structure.
- To make students capable of understanding and studying electrical and nuclear properties of molecules.

1. Molecular Symmetry (5 Hrs)

Symmetry elements and symmetry operation – Centre of symmetry, plane of symmetry, proper and improper axes of symmetry, identity, crystallographic point groups, Schoenflies symbol (determination of point groups not expected).

2. Solid State Chemistry (18 Hrs)

Classification: amorphous, crystalline – differences. Lattice, lattice energy (general idea), unit cell, examples of simple cubic, bcc and fcc lattices, calculation of number of molecules in a unit cell. Symmetry elements in crystals-seven crystal systems- Weiss and Miller indices, Bravais lattices, X-ray diffraction –Bragg's equation- Derivation, structure determination of NaCl by X-ray diffraction.

Theories of Solid: metallic bond, band theory, conductors, semiconductors and insulators, mention of super conductors. Magnetic Properties: classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferrimagnetic, permanent and temporary magnets.

3. Liquid State Chemistry (7 Hrs)

Liquids-Intermolecular forces, liquids compared with gases and solids (qualitative idea only), viscosity, surface tension (method of determination not expected), Liquid crystals – the intermediate phase between solid and normal liquid phases, thermographic behaviour, classification, structure of nematic and cholesteric phases.

4. Gaseous State **(7 Hrs)**

Gaseous State; Introduction – Kinetic molecular model of gases-average velocity, RMS velocity, most probable velocity (Derivation not required) – Gas laws-Boyles law-Charles law-Ideal gas equation-Behaviour of real gases-Deviation from ideal behaviour- van der Waals equation (Derivation not required)

5. Phase Equilibria **(9 Hrs)**

The phase rule, definition, equilibrium between phases, one component system – water system, two component systems: solid- liquid equilibrium – simple eutectic, lead-silver system, solid solution. Distribution law, partition coefficient, applications.

6. Nanomaterials and Nanochemistry **(8 Hrs)**

Introduction to nanoscience-Synthesis-Bottom-up and top-down approaches (Physical Vapour Deposition , Chemical Vapour Deposition , Chemical Precipitation, Laser Abelation and Sol-Gel) .

Green synthesis of nano Silver and nano Gold particles. Elementary idea about Fullerenes, Carbon Nano Tubes, Quantum Dots and their applications.

Photodetectors and Sensors

References

1. B R Puri, L R Sharma and K C Kalia, Principles of Inorganic chemistry, Milestone Publishers New Delhi 2013
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 40thedn. Vishal Pub. Co. Jalandhar (2003)
3. Ashcroft/ Mermin, Solid State Physics, Thomson Publishers
4. J. Tareen and T. Kutty, A basic course in Crystallography, University Press.
5. Anthony R West, Solid State Chemistry and its Applications, Wiley Eastern
6. Gurudeep Raj, 'Advanced Physical Chemistry' Goel Publishing House
7. P W Atkins, 'Physical Chemistry', Oxford University Press.
8. V S Muraleedharan and A Subramanian, Nanoscience and Nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009
9. T. Pradeep, Nano; The Essentials, McGraw-Hill education, New Delhi, 2006
10. R. J. Siby and R. A. Alberty, Physical Chemistry, John Wiley & Sons

Course Outcome

CO No:	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No:
1	Analyse the symmetry elements and symmetry operation	K1, K2, K4	1,2,3,4,7
2	Understand the theories of solids and explain its magnetic properties	K2, K3	1,2,4
3	Explain properties of liquids like viscosity, surface tension	K2, K3, K5	1,2
4	Analyse the kinetic behaviour of real gases and their deviation from ideal behaviour	K1, K2, K4	1,2,4
5	Relate phase equilibria and eutectic systems	K4, K5, K6	1,2,3,4,6
6	Acquire elementary idea about fullerenes, Carbon Nano Tubes, Quantum Dots and their applications.	K1, K2, K6	1,3,8
Knowledge Levels: K1-Remembering; K2-Uunderstanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.			

SEMESTER – III

UG21CH3CM02: Organic and Bio-organic Chemistry (For students who have opted Biological Sciences as Main)

Credits-3 **(54 Hrs)**

Aim:

The aim of the course is to promote understanding facts and concepts in inorganic and organic chemistry.

Objectives:

- To give the students a basic understanding of heterocyclic compounds, medicinal chemistry and and some biochemical processes

1. Chemistry and Agriculture (12 Hrs)

NPK representation, superphosphates, triple super phosphate, uses of mixed fertilizers, micronutrients and their role, bio-fertilizers, plant growth hormones. Pesticides-classifications with simple examples, mention of biopesticides.

Insecticides – stomach poisons, contact insecticides, fumigants. Method of preparation and use of DDT, BHC, pyrethrin.

Herbicides- structure and function of 2, 4,-D and 2,4,5 –T

Fungicides- inorganic and organic- Bordeaux mixture, diothiocarbamates. Excessive use of pesticides – environmental hazards.

2. Stereochemistry of Organic Compounds (8 Hrs)

Stereochemistry and stereoisomerism.

Geometrical Isomerism-cis and trans configurations, Determination of configuration and interconversion of cis-trans isomers.

Optical Isomerism-Optical activity, Chirality, Stereogenic Centre, Enantiomers and Diastereomers, Recemisation.

Conformation-Newman projections, Saw-horse projection, Conformations of Ethane, n-Butane, Cyclohexane (Substituted Cyclohexane not expected)

3. Aromaticity and Heterocyclic Compounds (12 Hrs)

Aromaticity – Huckel rule, preparation (any one method), properties, structure and aromaticity of furan, pyrrole, pyridine, indole. Pyrimidines and purines.

4. Metals In Biological Systems (11 Hrs)

Essential and trace elements in biological system. Metal deficiency and diseases –Iron, Zinc, Copper. Metal Toxicity- toxicity due to Copper overload, Iron , Plutonium and Mercury.

Chelation Therapy-Treatment for excess Iron, Copper, Mercury and Plutonium.

Biologically important molecules (structure not required): Haemoglobin – general functions of haemoglobin, transport of oxygen, pH of blood, myoglobin, cytochromes, Ferredoxin (elementary idea)

5. Drugs (6 Hrs)

Anti-Cancer Drugs-cis-Platin. Anti-Arthritis Drugs-Gold Compounds. Outline study and applications of antibiotics, sulpha drugs antipyretics, analgesics tranquilisers, and antidepressants (preparation not needed). Drug addiction abuse and prevention.

6. Waste Management (5 Hrs)

Effluent-definition and characteristics. Methods for waste water treatment-Disinfection, Electro Dialysis , Reverse Osmosis , Ultra Filtration technique.

Principles and strategies of green chemistry – 12 principles -examples

References

1. I. L Finar ,Organic Chemistry Vol 1&2, 6th Edition ,Pearson
2. S. M. Mukherji, S.P Singh, R. P. Kapoor , Organic Chemistry Vol.1, New Age International(P) Ltd., 2006 (Chapter)
3. H. J. Arnikar, Essentials of nuclear chemistry, Revised 4th edition, New Age International Publications ,1995.
4. C.N. R Rao, University General Chemistry, Macmillion
5. K S Tewari, N K Vishnoi , A Text Book of Organic Chemistry , 3rd edition , Vikas Publishing House Pvt.Ltd, 2006
6. G. T. Austin, Shreve's Chemical process Industries, 5th edition, McGraw Hill, 1984.
7. Rastogi, Biochemistry, Tata McGraw. Hill Publication, 1996.
8. B. Sreelakshmi, Food Science, New Age International Pvt Ltd, New Delhi
9. Thankamma Jacob, Text book of Applied Chemistry for Home Science and allied

Sciences, Macmillan.

CO No:	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No:
1	Understand the classification of pesticides, insecticides, fungicides and herbicides	K1, K2, K4	1
2	Implement methods to decrease the environmental hazards of pesticides	K3, K4, K6	1,2,8
3	Acquire a general idea about the stereochemistry of organic compounds	K2, K4	1,2,3,4,6
4	Explain the properties, structure and aromaticity of some heterocyclic compounds	K1, K2, K3	1,2,3,4,7
5	Analyse the structure and significance of biologically important molecules like haemoglobin, myoglobin, cytochromes etc.	K4, K5	1,2
6	List applications of antibiotics, sulpha drugs antipyretics, analgesics tranquillizers, and antidepressants	K1, K2, K4	1,2,3
7	Analyse the principles and strategies of green chemistry	K1, K2, K4, K6	1,8

Knowledge Levels: K1-Remembering; K2-Uunderstanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-

Creating.

SEMESTER - IV
UG21CH4CM01: Physical Chemistry – II
(For students who have opted Physical Sciences as Main)

Credits-3 **(54 Hrs)**

Aim:

To promote understanding of the basic facts and concepts in spectroscopy and to develop interest in students to study the structure and properties of matter.

Objectives:

- To help the students to get a basic idea about spectroscopy
- To enable the students to study the rules governing chemical reactions and factors influencing them.

1. Introduction to Spectroscopy (12 Hrs)

Interaction of electromagnetic radiation with matter, electromagnetic spectrum, quantization of energy, electronic, vibrational and rotational energy levels, Boltzmann distribution of energy (formula only), population of levels.

UV- Visible Spectroscopy: Beer Lambert's law, molar extinction coefficient and its importance, UV spectrum, max, chromophore, auxochrome, red shift, blue shift, types of transition.

Infra-red spectroscopy: vibrational degrees of freedom, types of vibrations – symmetric and asymmetric stretching and bending. Concept of group frequencies-frequencies of common functional groups in organic compounds.

Rotational Spectroscopy: diatomic molecules, determination of bond length.

2. Chemical Kinetics (6 Hrs)

Rate of reaction, rate law, order of reaction, molecularity of reaction. Integrated rate expression for first order reaction, half life, determination of order of reactions. Influence of temperature on reaction rate – Arrhenius equation, concept of activation energy, importance of activated complex.

3. Electrochemistry And Electromotive Force (18 Hrs)

Introduction; Faraday's Laws of Electrolysis, Electrochemical equivalent and Chemical Equivalent, Specific Conductance, Equivalent conductance and molar conductance-Variation of conductivity and molar conductivity with dilution-Kohlrausch's law-Degree of ionization of weak electrolytes Application of conductance measurements – Determination of degree of dissociation of weak electrolytes, conductometric titrations involving strong acid-strong base.

Galvanic cells-Types of Electrodes –Reference electrodes - Standard Hydrogen Electrode and Calomel Electrode , Indicator Electrodes-Metal-Metal ion Electrodes, quinhydrone electrode and Redox Electrodes. Standard Electrode Potential-Nernst Equation.

Fuel Cells-– the hydrogen – oxygen fuel cell. potentiometric titrations of acid-base and redox reactions-Precipitation Reactions.

4. Surface Chemistry, Colloids and Catalysis (12 Hrs)

Adsorption – types of adsorption of gases by solids, factors influencing adsorption, Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation not required).

Colloids: preparation, properties – optical and electrical, electric double layer, coagulation, electrophoresis, electroosmosis, surfactants, micelle, applications of colloids.

Catalysis-Types of catalysis – Homogenous and Heterogeneous Catalysis. Exampes.

5. Photochemistry (6 Hrs)

Laws of Photochemistry, photochemical process – primary and secondary, quantum yield. Basic Concepts of Photosensitized reactions, flash photolysis and chemiluminescene. Frank-Condon principle – fluorescence and phosphorescence.

References

1. C. N. Banwell, E.M. McCash, Fundamentals of Molecular Spectroscopy , 4thedn. Tata McGraw – Hill Pub. C. Ltd. New Delhi.
2. Bruce H. Mahan,University Chemistry 3rdedn.
3. P. Atkins. J. Paula, Atkins Physical Chemistry. 8thedn.Oxford University Press, 2006.

4. B. R. Puri, L.R. Sharma, M. S. Pathania, Elements of Physical Chemistry, 40th edn.
Vishal Pub. Co. Jalandhar (2003).
5. D L Pavia , G M Lampman, G S Kriz , Introduction to Spectroscopy 3rd Edition Thomson Brooks /Cole,2001.

Course Outcome

CO No:	Upon completion of this programme, the students will be able to	Knowledge Level	PSO No:
1	Acquire knowledge of basic spectroscopic techniques	K1, K2, K3	1,2,3,4,6,7
2	Discuss the theories of chemical kinetics and factors influencing the rate of a reaction	K2, K3, K4	1,2,4,6
3	Explain the laws of electrochemistry and different types of electrochemical cells	K2, K5, K6	1,2,3,4,6
4	Analyse the modes of adsorption and colloids	K2, K4	1,4,8
5	Explain the mechanism of catalysis	K2, K4	1,2,3,4,8
6	Investigate the various photochemical processes	K4, K5	1,4

Knowledge Levels: K1-Remembering; K2-Uunderstanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

SEMESTER-IV

UG21CH4CM02: Advanced Bio-organic Chemistry

(For students who have opted Biological Sciences as main)

Credits-3 **(54 Hrs)**

Aim :

The aim of this course is to promote understanding of facts and concepts in bioorganic chemistry and to inculcate an awareness of health and environment.

Objectives:

To study:

- The classification and properties of amino acids
- Classification, properties and structure of carbohydrates
- Classification and characteristics of enzymes and mechanism of enzyme action.
- Fundamentals of vitamins, hormones, steroids, essential oils, lipids and alkaloids

1. Amino acids and proteins (12 Hrs)

Classification of amino acids, zwitter ion, general chemical properties of - amino acids, separation of amino acids, synthesis of glycine, alanine, phenyl alanine (any one method) Peptides – peptide bond, polypeptides. Proteins- amino acids as building block of proteins, classifications, prosthetic group, properties, denaturation. Structure of proteins- primary, secondary and tertiary and quarternary structure.

2. Carbohydrates (12 Hrs)

Classification of carbohydrates , preparation and properties of glucose, fructose and sucrose. Haworth configuration of -D glucose and -D glucose, -D fructose,-D fructose, maltose and cellobiose (ring size determination not expected). Mutarotation. Conversion of glucose to fructose and vice-versa. Structure of starch and cellulose. Industrial applications of cellulose.

3. Vitamins, Steroids, Hormones (10 Hrs)

Structure and biological activity of vitamin A, B and C.

Steroids- general introduction, cholesterol and bile acids.

Hormones (structure not required)- Introduction, steroid hormones peptide hormones, amine hormones, artificial hormones (general idea)

4. Lipids (5 Hrs)

Simple lipids and complex lipids- isolation- properties. Analysis of oils and fats- acid value, saponification value, iodine value.

Soaps-types of soaps, cleansing action of soap

Detergents- Introduction, types of detergents, LAS and ABS detergents, advantages over soap, environmental aspects

5. Natural Products (8 Hrs)

Terpenoids: Essential oils- isolation, isoprene rule. Elementary study of citral, geraniol and natural rubber.

Alkaloids- Isolation, general properties. Structure of coniine, nicotine, piperine

6. Health and Diet (7 Hrs)

Nutrient requirements-major and minor nutrients. Nutrient content of food-anorexia and obesity.

Artificial Sweeteners-Saccharin, Cyclamate, Aspartame (general idea)

Food flavours (names only) – Esters, Aldehydes and Heterocyclic compounds

Food Colours-Restricted use, Spurious colours

General discussion of emulsifying agents, preservatives, leavening agents, baking powder, yeast, Taste enhancers-MSG.

Role of MUFA and PUFA in preventing heart diseases.

Beverages-Soft Drinks- Soda-Fruit Juices-alcoholic beverages-Examples. Carbonation-addiction to alcohol-Cirrhosis of liver and social problems.

References

1. I. L. Finar, Organic Chemistry Vol 1&2, 6th edition, Pearson
2. K. S. Tewari, N. K. Vishnoi, A Text Book of Organic chemistry, 3rd edition , Vikas
   publishing House Pvt. Ltd ,2006.
3. Rastogi, Biochemistry, Tata McGraw –Hill Publication ,1996
4. Dr. A.C. Deb, Fundamentals of Biochemistry
5. C. N. R Rao, University General Chemistry, Macmillan.
6. B. Sreelakshmi, Food Science, New Age International Pvt Ltd, New Delhi
7. Robert S Boikess, Elements of chemistry

CO	Upon completion of this programme, the	Knowledge	PSO

No:	students will be able to	Level	No:
1	Acquire knowledge about the classification and properties of amino acids and proteins	K1, K2, K4	1,2
2	Understand the classification and properties of carbohydrates	K1, K2, K5	1,2,
3	Analyse the structure and biological activity of vitamins, steroids and hormones.	K4, K5, K6	1,2,3,
4	Evaluate the environmental aspects of soaps and detergents	K1, K2, K5	1,3,8
5	Apply various analytical techniques for the isolation of natural products	K2, K3, K6	1,2,6
6	Understand and analyse social problems related with health and diet	K2, K4, K6	1,2,3,8
Knowledge Levels: K1-Remembering; K2-Uunderstanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6- Creating.			

PRACTICAL-I
(Semester I and II)
(Common to physical sciences and life sciences)
UG21CH2CMP1: Volumetric Analysis

Microscale analysis can be incorporated

Standard solution must be prepared by the student.

1. Acidimetry and Alkalimetry

1. Standardization of HCl with standard Na_2CO_3 solution

2. Standardization of NaOH with standard oxalic acid solution

3. Estimation of any acid using standard NaOH

4. Estimation of any alkali using standard HCl.

2. Permanganometry

1. Standardization of $KMnO_4$ using (i) oxalic acid (ii) Mohr's salt

2. Estimation of Fe^{2+} in Mohr's salt and crystalline Ferrous Sulphate using standard $KMnO_4$.

3. Dichrometry

1. Estimation of Ferrous ions (external indicator)

2. Estimation of Ferrous ions (internal indicator)

3. Estimation of $FeSO_4.7\ H_2O$ (external indicator)

4. Iodimetry and Iodometry

1. Standardization of Iodine solution

2. Standardization of Sodium thiosulphate

3. Estimation of $KMnO_4$

4. Estimation of Copper

References

1. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson
2. Vogel's Textbook of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd.
3. G. D. Christian, Analytical Chemistry, John Wiley and Sons
4. R.D Day, A.L. Uderwood, Quantitative analysis,6th Edn., Prentice Hallof India Pvt. Ltd.
5. Prof. S. Vijayakumar, Dr. M.R. Sudarsankumar, Dr. K. Sankar, Dr. S. Balachandran, Practical Chemistry, B.Sc Complementary Course in Chemistry, Souparnika Publications

PRACTICAL-II
(Semesters III and IV)

Credits-2 **(72 Hrs)**

UG21CH4CMP1: Physical Chemistry Practicals
(For students who have opted Physical Sciences as Main)

Microscale analysis can be incorporated

1. Determination of Partition coefficient of a non volatile solute
2. Transition temperature of salt hydrates, eg. Sodium thiosulphate, Sodium acetate etc.
3. Critical solution temperature of phenol water system
4. Heat of Solution KNO_3, NH_4Cl
5. Heat of neutralization
6. Determination of equivalent conductance of an electrolyte

7.Conductometric titration of strong acid Vs. strong base

8. Potentiometric titrations : Fe^{2+} vs. $Cr_2O_7^{2-}$and Fe^{2+P} vs. $KMnO_4$

9. Determination of molecular weight by Rast's method. (using naphthalene, camphor or

biphenyl as solvent and acetanilide, p–dichlorobenzene etc. as solute)

10. Kinetics of simple reactions, eg. Acid hydrolysis of methyl acetate

References

1. W. G. Palmer: 'Experimental physical chemistry', Cambridge University Press.
2. J. B. Yadav: Advanced Practical Physical Chemistry Goel Publishing House.
3. R. C. Das and B. Behra; 'Experiments in Physical Chemistry', Tata McGraw hill.
4. K. K. Sharma : 'An Introduction of Practical Chemistry': Vikas Publishing House, New Delhi 104

UG21CH4CMP2: Organic Chemistry Practicals
(For students who have opted Life Sciences Main)

Microscale analysis can be incorporated

1. Tests for elements: Nitrogen, Halogen and Sulphur
2. Determination of Physical constants
3. Study of reactions of common functional groups

4. Qualitative analysis with a view to characterization of functional groups and identification of the following compounds: Naphthalene, anthracene, chlorobenzene, benzyl chloride, p-dichlorobenzene, benzyl alcohol, phenol, o-, m- and p- cresols, - naphthol, - naphthol, resorcinol, benzaldehyde, acetophenone, benzophenone: benzoic acid, phthalic acid, cinnamic acid, salicylic acid, ethyl benzoate, methyl salicylate, benzamide, urea, aniline, o-, m- and p- toluidines, dimethyl aniline, nitrobenzene, o-nitrotoluene, m-dinitrobenzene and glucose

5. Organic preparation involving halogenation, nitration, oxidation, reduction, acetylation, benozylation, hydrolysis, diazotization

6. Isolation of an organic compound from a natural source

References:

1. A. I Vogel, A Text Book of Practical Organic Chemistry, Longman.
2. F. G. Mann and B.C. Saunders, 'Practical Organic Chemistry' Fourth Edition, Pearson Education.
3. V. K. Ahluwalia and S. Dhingra , Comprehensive Practical Organic Chemistry, Universities Press.

PROJECT REPORT GUIDELINES

PROJECT EVALUATION: (Maximum Marks 100)

All students are to do a project in the area of the core course. This project can be done individually or in groups (not more than five students) for all subjects which may be carried out in or outside the campus. Special sanction shall be obtained from the Principal to those new generation programmes and programmes on performing arts where students have to take projects which involve larger groups. The projects are to be identified during the II semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and is to be produced before the examiners (Internal and External) appointed by the Controller of Examinations. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme.

For Projects

a) Marks of External Evaluation :80

b) Marks of Internal Evaluation : 20

Components of External Evaluation of Project	**Marks**
Dissertation (**External)**	50
Viva – Voce (**External)**	30
Total	**80**

*Marks for Dissertation may include study tour report if proposed in the syllabus

***Components of Internal Evaluation of Project**	**Marks**
Punctuality	5
Experimentation/Data collection	5
Knowledge	5
Report	5
Total	**20**

COMPREHENSIVE VIVA GUIDELINES

SEMINAR/VIVA VOCE

A student shall present a seminar in the Fifth semester for each course and appear for Viva- voce in the sixth semester for each course.

MAR ATHANASIUS COLLEGE (AUTONOMOUS) KOTHAMANGALAM
FIRST SEMESTER CBCS BSc DEGREE EXAMINATION
Core Course: UG21CH1CR01 THEORETICAL AND INORGANIC CHEMISTRY
MODEL QUESTION PAPER

Time: 3 hrs Total marks: 60

Section A
(Answer any 10 questions. Each question carries 1 mark)

1. What is inorganic benzene? What is its structure?
2. Define electron gain enthalpy.
3. Give the structure of perdisulphuric acid
4. Calculate the effective nuclear charge felt by a 3d electron of chromium atom(Z = 24)
5. Why do lithium and magnesium show similarities in properties?
6. The Victor Mayer determination of molecular weight of acetone (mol.mass58) by a student showed a value as 60. Calculate absolute error and relative error.
7. What is meant by a well behaved wave function?
8. Why doesn't the wave nature of a moving cricket ball become evident to an observer?
9. What is the radius of the first orbit of the hydrogen atom?

10. What is the physical significance of Ψ^2?
11. What is Zeeman effect?
12. State the de Broglie relation.

(10 x 1 = 10 marks)

Section B

(Answer any 6 questions. Each question carries 5 marks)

13. The heavier p block elements are reluctant to show maximum oxidation state. How would you account for it?
14. What are pseudohalogens? Explain why they are called so?
15. Polymeric boron nitride is a much less conductor of electricity than graphite. Why?
16. Give the shapes of XeF_2, XeF_4 and XeF_6
17. Analysis of a sample of iron ore gave the following percentage values for the iron content 7.0, 7.21, 7.12, 7.09, 7.16, 7.14, 7.07, 7.14, 7.18, 7.11. Calculate the mean and the standard deviation.
18. How Bohr's atom model is able to explain the spectrum of hydrogen atom?
19. Explain the importance of Pauli's exclusion principle and Hund's rule of maximum multiplicity
20. How would you prove that electrons possess wave characteristics? Explain.
21. State and Explain Heisenberg's uncertainty principle with suitable examples.

(6 x 5 = 30 marks)

Section C

(Answer any 2 questions. Each question carries 10 marks)

22. Set up the Schrodinger wave equation for a particle in a one-dimensional box. Solve it and get an expression for the energy of electrons.
23. Derive an expression for the frequency of the spectral lines of hydrogen based on Bohr's theory.
24. What are the common errors in quantitative analysis? How can these errors be eliminated?
25. Give an account of the structure and bonding of diborane. What is its styx number?

(10 x 2 = 20 marks)

MAR ATHANASIUS COLLEGE (AUTONOMOUS) KOTHAMANGALAM
B Sc PROGRAMME (C.B.C.S) - CHEMISTRY COMPLEMENTARY COURSE
MODEL QUESTION PAPER - First Semester
UG21CH1CM01 – BASIC THEORETICAL AND ANALYTICAL CHEMISTRY
(Common for Students who have opted Life Sciences, Family& Community Science, Physical Sciences and Geology as core)

Time : 3 HrsTotal Marks : 60

PART A

(Answer any 10 questions. Each question carries 1 mark)

1. Define and explain Hund's rule of maximum multiplicity.
2. Derive de Broglie equation and explain the terms.
3. Define and explain the Aufbau principle.
4. Define system and surroundings.
5. Define molarity and molality.
6. What are Ka, Kb, pKa and pKb?

7. What are significant figures? Explain with examples.
8. What are the differences between precision and accuracy?
9. What are primary standards? Give one example.
10. Write the electronic configuration of Cr (24) and Cu (29).
11. State second law of thermodynamics.
12. Draw the shape of $d_{x^2-y^2}$ and d_{xy}.

(10 x 1 = 10 marks)

PART B

(Answer any 6 questions. Each question carries 5 marks)

13. Write a brief note on Dual nature of matter and radiation.
14. State and explain Heisenberg's uncertainty principle.
15. What is Photoelectric effect? Derive Einstein photoelectric equation.
16. Discuss about microanalysis, double burette method of titration.
17. What is common ion effect and write a note on its applications.
18. Define hydrogen bonding. Write a note on intra and intermolecular hydrogen bonding with its applications.
19. Write a note on the preparation of a standard solution. Illustrate with an example.
20. Draw the MO diagram of N_2 and calculate its bond order and magnetic property.
21. What is Gibb's free energy? Write about the conditions for equilibrium and spontaneity based on ΔG values.

(6x 5 = 30 marks)

PART C

(Answer any 2 questions. Each question carries 10 marks)

22. Discuss various types of bonding and briefly explain the theories of chemical bonding.
23. Write an essay on the quantum numbers and shapes of atomic orbitals.
24. Discuss the concept of chemical equilibrium. Explain Arrhenius, Lowry-Bronsted and Lewis theories.
25. Write an essay on the principles of volumetric analysis with special mention of acid-base and redox titrations.

(2 x 10 = 20 marks)

B.Sc. DEGREE (CBCS) MODEL QUESTION PAPER
CHEMISTRY CORE - SEMESTER II
THEORETICAL AND ANALYTICAL CHEMISTRY

Time: 3 Hrs **Max. Marks: 60**

Section A

(Answer ten questions. Each question carries 1 mark)

1.Define octet rule. What are its applications?
2.Write Born-Lande equation and explain the terms.
3.What is Debye force?
4.Which is more stable O_2 or O_2^+? Why?
5.Why do silver halides have low solubility in water?
6.What are London dispersion forces?
7.How can we determine the percentage ionic character in a molecule?
8.A solution prepared by adding 2 g of a substance A to 18 g of water. Calculate the mass percentage of the solute.
9.What is a chromatogram?
10.Give two uses of TLC

11. Define molality.
12. What is the principle of differential migration in chromatography?

(1x10=10)

Section B

(Answer any 6 questions. Each question carries 5 marks)

13.Define hybridization. What are its characteristics?

14.What is dipole moment? Explain why the dipole moment of hydrogen halides decreases from HF to HI.

15.Explain polarisability of an anion and polarising power of a cation?

16.Distinguish between bonding molecular orbital and antibonding molecular orbital.

17.Differentiate between intermolecular and intra molecular hydrogen bonding with suitable examples. Explain the effects of hydrogen bonding.

18.Explain the band theory of metals.

19.Define bond order. Calculate the bond order of N_2 and O_2 molecule.

20.Compare VB and MO theories.

21.Write a note on radial paper chromatography.

(6 x 5 =30)

Section C

(Answer any 2 questions. Each question carries 10 marks)

22. Explain Born- Haber cycle with an example. What are the applications?

23. (a)Discuss VSEPR theory. Using the theory, assign the shapes of (i) XeF_2 (ii) XeF_4 and (iii) XeF_6 offering approximate explanations in each case.

24. (a) Draw the MO energy level diagram of CO molecule and explain its properties.

(b) He_2 molecule does not exist. Why?

25. (a)Illustrate metallic bonding on the basis of free electron theory. How does it explain (i) Thermal and electrical conductivity of a metal. (ii) Metallic lustre

(b)What are the limitations of free electron theory?

(2 x 10 =20)

MAR ATHANASIUS COLLEGE (AUTONOMOUS) KOTHAMANGALAM
THIRD SEMESTER CBCS BSc DEGREE EXAMINATION
Core Course
UG21CH3CR01: ORGANIC CHEMISTRY-I
MODEL QUESTION PAPER

Time: 3 hrs Total marks: 60

Section A
(Answer any 10 questions. Each question carries 1 mark)

1. Write down the structural formula of Hex-4-yn-2-one.
2. Differentiate between inductive effect and electromeric effect
3. Explain the structure of benzyne.
4. Differentiate between homolysis and heterolysis.
5. What do you understand by the term elimination-addition reaction? Give one example.
6. Aryl halides undergo nucleophilic aromatic substitution only with extreme difficulty. Give reason.
7. Distinguish between enantiomers and diastereomers
8. Suggest the possible reason why a peroxide effect is given by HBr, not by HCl or HI.

9. What is Baker-Nathan effect?
10. State Anti markownikoff's rule and give an example?
11. State Bayer's strain theory with an example.
12. The number of optical isomers possible for the compound $CH_3CH(Cl)COOH$?

Section B

(Answer any 6 questions. Each question carries 5 marks)

13. What are inductive effects? How do these effects affect the chemical properties of organic compounds?
14. Describe the aromatic electrophilic substitution reactions of Naphthalene.
15. Give the mechanisms of aromatic nucleophilic substitution reaction.
16. Draw the Newman's projection formula of chair and boat conformations of cyclohexane?
17. Write a note on peroxide effect. Explain with an example.
18. What are the rules for assigning E or Z configuration to geometrical isomers? Assign the configuration to trans-2– butene.
19. Write a note on E1 and E2 mechanisms of elimination reaction?
20. Write a note on asymmetric synthesis.
21. Sate Markownikoff's rule and explain the mechanism of addition of HBr to propene.

Section C

(Answer any 2 questions. Each question carries 10 marks)

22. (a) Describe the Cahn-Ingold-Prelog rules for specifying the absolute configuration of stereo isomers with suitable examples.

    (b) Discuss the methods used in distinguishing geometrical isomers.

23. (a) Optical isomerism of compounds without asymmetric carbon atom.

    (b) What are the methods are available for resolution of racemic compounds?
24. Discuss the mechanisms of S_N1 and S_N2 reactions. Enumerate the differences between S_N1 and S_N2 mechanisms.
25. What are reaction intermediates? Give a brief account of structure and stability of reaction intermediates.

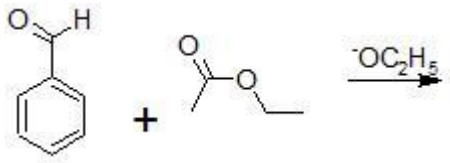
(10 x 2 = 20 marks)

MAR ATHANASIUS COLLEGE (AUTONOMOUS) KOTHAMANGALAM
FOURTH SEMESTER CBCS BSc DEGREE EXAMINATION
Core Course
UG21CH4CR01: ORGANIC CHEMISTRY-II
MODEL QUESTION PAPER

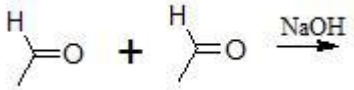
Time: 3 hrs Total marks: 60

Section A
(Answer any 10 questions. Each question carries 1 mark)

1. Give the products of the following reaction.



2. Write down the product and mechanism of addition of sodium bisulphite to acetaldehyde.
3. How do you explain why acetone is less reactive than acetaldehyde?
4 Predict the product of the following reaction.



5. Give one method of preparation of anthranilic acid.
6. How will you differentiate between an ordinary ketone and methyl ketone?
7. How can you convert acetone into propane?
8. Explain the basic nature of guanidine
9. Why are carboxylic acids much stronger than alcohol?
10. Give any one method for preparation of methanol.
11. Write the structural formula of resorcinol.
12. What is pinacolone? How it is obtained. (10 x 1 = 10)

Section B

(Answer any 6 questions. Each question carries 5 marks)

13. Write any one method for the preparation of urea.How does it react with nitrous acid?What is Biuret reaction?
14. Give one method of preparation and reactions of citric acid.
15. How you can convert (a) acid anhydride into amide (b) amide into amine (c) ester into another ester (d) acid chloride into anhydride?
16. Give any five synthetic applications of acetoacetic ester.
17. Write down the mechanism of (a) Mannich reactions (b) Wittig reaction.
18. How will you convert (a) anthranilic acid into aniline (b) cinnamic acid to dibromo-cinnamic acid (c) acrylic acid to sodium acrylate (d) malic acid into maleic acid?
19. Give an account of the oxidative cleavage of glycol with periodic acid.
20. What is Fries rearrangement? Explain it with a suitable mechanism.
21. Explain Lederer- Mannase reaction with mechanism. (6 x 5 = 30)

Section C

(Answer any 2 questions. Each question carries 10 marks)

22. Write down the mechanism of (a) Clemmensen (b) Wolff-Kishner (c) Meerwein-Ponndorf-Verley (d) LiAlH4 and (e) NaBH4 reduction of carbonyl compounds.
23. Give one method of preparation and reactions of acid chlorides and anhydrides.
24. Write a note on the method of preparation and reactions of benzene sulphonic acid.
25. a)Write a note on ascend and descend in alcohol series.
b)Explain the chemistry of methanol poisoning and harmful effects of ethanol on the human body.

(2 x 10 = 20)

MAR ATHANASIUS COLLEGE (AUTONOMOUS), KOTHAMANGALAM
CBCS B Sc. CHEMISTRY-CORE
SEMESTER V–MODEL QUESTION PAPER
ORGANIC CHEMISTRY-III

Time: **3** hours Total Marks: **60**

Section A (Answer any**10**questions. Each question carries **1** mark)

1. Give the structure of Isoprene.
2. What happens to natural rubber during mastication?
3. What is Diel's hydrocarbon? Write its structure.
4. What is the chemical reaction taking place in the hardening of oils?
5. Name the vitamin produced in the skin on exposure to sunlight. Write its deficiency disease.
6. Give the names of 2 unsaturated acids in lipids.
7. What is rubber mastication?
8. Describe Chichibabin reaction?
9. Explain briefly on transcription?
10. What are nucleotides?

11. What are essential amino acids? Give one example.
12. What is vulcanisation?

Section B (Answerany **6** questions. Each question carries **5** marks)

13. Write a brief note on acid value, saponification value, iodine value and RM value.
14. Discuss the Induced fit model for the enzyme catalysis.
15. Discuss the structure elucidation of nicotine with its synthesis.
16. Explain the different methods for the extraction of oils and fats.
17. Discuss the structure, function and deficiency diseases of vitamins A and C.
18. A compound A($C_6H_{12}O_6$) is oxidised by Br_2 water into monobasic acid B. It also reduces Tollen's reagent and reacts with HCN to give a compound C which on hydrolysis gives a compound D. On treating D with HI/redP, n-heptanoic acid is obtained. Compound A on treatment with excess phenyl hydrazine gave osazone. Give the structures of A, B, C & D. Name the compound A and draw its cyclic form.
19. An optically active amino acid(A) can exist in three forms depending on the pH of the medium. If the molecular formula of (A) is $C_3H_7NO_2$ write
    (i) Structure of compound(A) in aqueous medium. What are such ions called?
    (ii) In which medium will the cationic form of compound (A) exist?
    (iii) In alkaline medium towards which electrode will the compound (A) migrate in electric field. Explain?
20. Distinguish between iodine value and acid value.
21. Write a note on enzyme inhibitors.

Section C (Answerany **2** questions. Each question carries 10 marks)

22. a) Write a note on steroid hormones.
    b) Explain the two mechanisms of enzyme action.

23 (i) Give an account of Merrifield's solid phase peptide synthesis. What are its advantages?

(ii) What is meant by Primary structure of proteins. What are the important methods used for elucidation of primary structure of proteins?

24. Describe the chemical reactions of lipids.
25. Discuss the sources, structure and functions of cholesterol.

MAR ATHANASIUS COLLEGE (AUTONOMOUS), KOTHAMANGALAM
CBCS B Sc. CHEMISTRY-CORE
SEMESTER VI–MODEL QUESTION PAPER
PHYSICAL CHEMISTRY-IV

Time: 3 hrs **Total marks : 60**

Section A

(Answer any 10 questions. Each question carries 1mark)

1. What are maximum boiling azeotropes?
2. State Nernst distribution law.
3. State Raoult's law of relative lowering of vapour pressure.
4. State Boyle - van't Hoff law for solutions.
5. Define cryoscopic constant.
6. An aqueous solution of urea boils at 373.078 K. What is its molality? K_b for water = 0.52 K kg mol $^{-1}$ and its boiling point = 373 K.
7. Explain Walden's rule.
8. What is meant by electrode potential?
9. Write the Henderson equation.
10. What are concentration cells?
11. The EMF of the Daniel cell is 1.1 volt, calculate the change in free energy in KJ.
12. State Faraday's second law of electrolysis.

Section B

(Answer any 6 questions. Each question carries weightage 1)

13. Explain the term critical solution temperature with the help of a phase diagram for a partially miscible binary system of liquids.
14. Explain the factors affecting solubility of a gas in a liquid.
15. Derive thermodynamically the expression for relative lowering of vapour pressure.
16. (a) Define the term molal boiling point elevation constant of a solvent.
    (b) The boiling point of pure acetone is 56.2^{o}C. A solution of 0.81 g of non- volatile solute in 10 g of acetone boiled at 58.5^{o}C. What is the molecular weight of the solute if the ebullioscopic constant for acetone is 1.71 K mol $^{-1}$ kg?
17. What is Kohlrausch's law? What are its applications?
18. Give an account of the abnormal ion conductivity of hydrogen and hydroxyl ions.
19. How will you determine solubility product by EMF measurements?
20. Explain hydrogen- oxygen fuel cells.
21. Explain the principle and applications of common ion effect.

Section C

(Answer any 2 questions. Each question carries 10 marks)

22. (a) How will you determine liquid junction potential using EMF measurements?

    (b) Calculate the liquid junction potential at 250C between two solutions of HCl having mea ionic activities of 0.01 and 0.001 respectively. The transport number of H+ ion in HCl may be taken as 0.83
23. How will you determine the transport number of an ion using the moving boundary method?
24. Explain the term molal elevation constant. Derive thermodynamically the relation between boiling point elevation of a solution and molality of solution. How is the expression utilized for determination of molecular mass of a non-volatile solute.
25. What is corrosion? Explain the forms of corrosion and its monitoring and prevention methods.