ST.TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM
Affiliated to Mahatma Gandhi University, Kottayam

CURRICULUM AND SYLLABI FOR THE PROGRAMME

B.Sc. CHEMISTRY
Program Code: BCHE

and
Complementary Courses

Under Choice Based Credit & Semester System
(2023 Admission Onwards)

St. Teresa's College (Autonomous), Ernakulam

Department of Chemistry

Board of Studies in Chemistry (2021-2024)

Sl. No	Category	Name	Designation	Official Address
1	Chairperson (HOD)	Dr. Jaya T. Varkey	Associate Professor	Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam
2	Faculty Member	Dr. Ushamani M.	Associate Professor	Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam
3	Faculty Member	Dr. Saritha Chandran A.	Assistant Professor	Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam
4	Faculty Member	Dr. Elizabeth Kuruvilla	Assistant Professor	Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam
5	Faculty Member	Dr. Shanty A. A.	Assistant Professor	Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam
6	Faculty Member	Dr. Annu Raju	Assistant Professor	Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam
7	Faculty Member	Dr. Maria Linsha P. L.	Assistant Professor	Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam
8	Faculty Member	Dr. Ambili K. S.	Assistant Professor	Department of Chemistry, St. Teresa's College

				(Autonomous), Ernakulam
9	Faculty Member	Smt. Priya K.	Assistant Professor	Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam
6	Subject Expert -1 Outside MG University	Dr. Mahesh Hariharan	Professor	School of Chemistry, Indian Institute of Science Education and Research, Maruthamala P.O, Vithura, Thiruvananthapuram.
7	Subject Expert-2 Outside MG University	Dr. Joshy Joseph	Principal Scientist, CSIR-NIIST, and Associate Professor, AcSIR	CSIR-NIIST, Industrial Estate, Pappanamcode, Thiruvananthapuram
8	University Nominee	Dr. Anu Gopinath	Assistant Professor	Department of Aquatic Environment Management, KUFOS
9	Representative from Industry/ Corporate Sector/ Allied field related to placement	Dr. Pushpakumari K.N.	Assistant Vice President (R & D)	AVT Natural Products Ltd., Marampilly P.O, Aluva.
10	Alumni Representative	Dr. Derry Holladay M. G.	Assistant Professor	Department of Chemistry, University of Calicut, Kozhikode

PREFACE

The curriculum, which encompasses the totality of student experience, should ensure a collective and dedicated effort to birth an inspiring academic culture in a campus. It is this vision of quality knowledge, its production and transmission, that has fueled the Teresian quest for essential and elemental student development. St. Teresa's College has taken meticulous care in the conception of the new well-balanced curriculum by retaining the fundamental prerequisites mentioned by the University/Higher Education Council. With the constraints of a prescribed syllabus in mind, we have created an academic sanctuary, where a deeper access to knowledge is achievable to students and teachers as well.

The Syllabus restructuring of 2022 instigates opportunities of real-world learning to equip a modern scholar with the practicality of experience. As an autonomous institution under Mahatma Gandhi University, St. Teresa's College offers a significant number of Programmes with definite placement windows to the learners. Student knowledge and training across a range of subject areas is efficiently enriched by engaging them in work-based learning, as provided by the revised and restructured curriculum.

The indefatigable effort taken by the teachers in developing Programmes and Course outcomes is commendable. The blossoming of the cognitive and intellectual skills of the scholars, the initiation of a research mentality, and pragmatic skill sets to venture out confidently into a professional space, are the core off-shoots that are anticipated. The curriculum should equip the students to be educators themselves, with a voice that echoes global effectiveness.

I congratulate the efforts taken by the Principal Dr. Alphonsa Vijaya Joseph and her team for restructuring the syllabus in keeping with the latest demands in academia. We trust that the syllabus will transform minds to embark upon higher academic summits and thereby mould learners who will make significant contributions to the world. We look forward to sharing the outcomes of our restructured curriculum and the positive changes that would reshape the academic lives of all our scholars.

Dr. Sr. Vinitha
Manager

FOREWORD

The most significant characteristic of an autonomous college is its commitment to curriculum renewal or revision. Academic autonomy has granted the college the freedom to fine tune the syllabus keeping in mind the changing needs of the new generation of students, the new educational scenario in the global context and incorporation of skill based curricula. Revision of the syllabus implies responsibility and accountability and this in turn leads to excellence in academics and proactive governance. Education in the current scenario throws up a multitude of challenges and the curricula and syllabi ought to reflect the paradigm shift that has occurred in the various disciplines.

A revision of the syllabus is implemented by modifying the curriculum after review to evaluate the effectiveness of the curriculum after it has been implemented and to reflect on what students did and did not get out of it. In line with the new Educational policy, a big educational reform can be effected by restructuring of syllabi to maintain a high level of quality in the standard of education that we impart.

The three themes under Higher Education relevant to policy initiative for restructuring of the curriculum i.e., integrating skill development in higher education, linking higher education to society and integration of new knowledge are considered with utmost importance during revision of the syllabus.

Outcome-Based Education emphasizes that the learning process is innovative, interactive and effective, where the main goal is student achievement at the end of the learning period. St. Teresa's College in its pursuit of imparting quality education has adopted Outcome Based Education (OBE) system that involves restructuring of curriculum, academic processes, teaching methodologies, assessment and evaluation systems in education to reflect the achievement of high order learning. It is a student-centric instruction model that focuses on measuring student performance through outcomes that include knowledge, skills and attitudes.

The revised syllabus and curriculum is the result of the combined efforts of the members of the Board of studies, curriculum expert committee and the syllabus committee who worked as a team to revise the syllabus and curriculum in the stipulated period. Active consultations were held with various stakeholders to elicit multiple perspectives in higher education which were incorporated in the new curriculum.

With sincere gratitude I acknowledge the instinct support and constant guidance extended by Rev. Dr. Sr. Vinitha, Provincial Superior and Manager, Rev. Sr. Emeline, Director, Dr. Sajimol Augustine M., Senior Administrator, Smt. Betty Joseph, Vice-Principal and Dr. Beena Job, Dean of self-financed programmes. I specially thank the team headed by Dr. Betty Rani Isaac, the Heads of the Departments and all the faculty members for their diligence, commitment and exceptional contribution towards this endeavour.

Prof. Alphonsa Vijaya Joseph
Principal

ACKNOWLEDGEMENT

To begin with I bow my head to the divine grace of Almighty for His heavenly guidance and blessings during the entire process of restructuring the syllabus. I remember with gratitude the support of our Provisional Superior and Manager Rev.(Dr.)Sr.Vinitha, Principal Prof. Alphonsa Vijaya Joseph, Director Sr. Emeline, Senior Administrator Dr. Sajimol Augustine M., Vice Principal Smt. Betty Joseph, IQAC coordinator Dr. Kala M. S, curriculum committee and all the members of the syllabus revision committee during the syllabus restructuring process. I am also grateful to all the esteemed members of the Board of Studies, Dr. Mahesh Hariharan, Dr. Joshy Joseph, Dr. Anu Gopinath, Dr. Pushpakumari K. N, Dr. Derry Holaday M. G., for their constructive suggestions and contributions. I am deeply indebted to the faculty members of the Chemistry department, Dr. Ushamani M, Dr. Saritha Chandran A, Dr. Elizabeth Kuruvilla, Dr. Shanty A A., Dr. Annu Raju, Dr. Maria Linsha P. L., Ms. Priya K., and Dr. Ambili K S for the hard and relentless work they have put in during the compiling of the restructured syllabus.

Dr. Jaya T. Varkey
Chairperson,
Board of Studies in Chemistry,
St. Teresa's College (Autonomous).

CONTENTS

B.SC. PROGRAMME IN CHEMISTRY UNDER CHOICE-BASED CREDIT AND SEMESTER SYSTEM (2023 ADMISSION ONWARDS)

PREAMBLE

The B.Sc. Chemistry programme is designed with the aim to attract students who have a passion to discover the fascinating world of chemistry. The syllabus is designed so that the student starts from the basic concepts of chemistry, thus laying a strong foundation in their pursuit of excellence. Topics varying from synthetic organic chemistry, nanochemistry, spectroscopy, environmental studies & human rights, coordination chemistry, bio-organic chemistry, physical chemistry, analytical chemistry, group theory & its applications, quantum mechanics etc. are taught. Chemistry in everyday life is taught as open course in V semester and Nano chemistry & Nanotechnology is taught as Choice-Based core course in VI semester. The content of the complementary course in chemistry is designed in such a way that it contains topics relevant to the students of other programmes. The practical sessions will help the students to gain sufficient skills in organic and inorganic analysis, preparations, solvent extraction, chromatography, as well as quantitative analysis.The courses in each semester is chosen in such a manner that a balance is struck between the different topics included and the students do not feel overburdened and lose interest in opting for higher studies in chemistry. The inclusion of group project work helps in team building and peer respect as well as putting to use the strong and weak characteristics of the group members. Ample opportunities are also provided to enable the student to improve their scientific writing skills through assignments in the first four semesters. The project evaluation is structured in such a way as to lay a foundation of research, systematic project report preparation and to enhance the presentation skills of the student before an audience. The syllabus of the B.Sc. Chemistry programme is thus designed to enable the students to willingly pursue higher studies in chemistry.

Outcome based education involves assessment and evaluation practices in education reflecting the attainment of expected learning and mastery in the programme. It is a systematic way to determine if a programme has achieved its goal. This approach of learning makes the student an active learner, the teacher a good facilitator and together they lay the foundation for life-long learning. The process includes framing of specific course outcomes at various appropriate levels of taxonomy, mapping the course outcomes of each course with the Programme Specific Outcomes and finally calculating the course attainment based on the marks scored by the student in both the Internal and External assessments.

PROGRAMME OUTCOMES (PO)

On completion of an undergraduate programme from St. Teresa's College (Autonomous), Ernakulam, students should be able to demonstrate the programme outcomes listed below:

PO1. ***Disciplinary knowledge***

- ✓ Demonstrate mastery of the fundamental knowledge and skills required in the discipline to function effectively as an entry-level professional in the field.

PO2. ***Scientific Temper***

- ✓ Experiment with new approaches, challenge existing knowledge boundaries and take informed action to solve problems related to society.
- ✓ Identify, define, and deal with problems through logical, analytical and critical thinking acquired from different domains of knowledge.

PO3. ***Research and Digital Competence***

- ✓ Develop a research culture for life long learning and demonstrate competency in creating new knowledge.
- ✓ Analyze and choose from available data and information sources to communicate, collaborate and network through a range of digital media.

PO4.***Communication Skills***

- ✓ Develop language proficiency through interactions embedded in meaningful contexts.
- ✓ Demonstrate communicative competence particularly using technology in social and global environments.

PO5. ***Leadership, Teamwork and Interpersonal Skills***

- ✓ Function effectively both as leader and/or member of a team.
- ✓ Collaborate and interact effectively with others.

PO6. ***Moral & Ethical Awareness and Social Responsibility***

- ✓ Demonstrate social and national responsibility.
- ✓ Engage in activities that contribute to the betterment of society, with a preferential option for the economically challenged and the marginalized.

PROGRAMME SPECIFIC OUTCOMES (PSO)

On completion of the BSc. Programme in Chemistry, students should be able to demonstrate the programme specific outcomes listed below:

PSO1: Describe the major concepts and theoretical principles in Chemistry (Understand)

PSO2: Solve problems using basic understandings in chemistry, physics and mathematics (Apply)

PSO3: Apply scientific knowledge to design, perform, record and analyze experiments (Apply)

PSO4: Develop communication skills to identify, investigate, formulate and transmit new ideas and concepts (Apply)

PSO5: Develop analytical, creative, cognitive skills with social responsibility and environmental consciousness (Apply)

ELIGIBILITY

Pass in +2 Examination with Chemistry as an optional subject.

PROGRAMME DESIGN

The U.G. programme in Chemistry must include (a) Common courses, (b) Core courses, (c) Complementary Courses, (d) Choice based courses (e) Open courses (f) Project work and Comprehensive viva - voce. No course shall carry more than 4 credits. The student shall select any one open course in Semester V offered by any department other than their parent department including the physical education department, depending on the availability of infrastructure facilities, in the institution. The number of courses for the restructured programme should contain 12 compulsory core courses,1 open course,1 choice based course from the frontier area of the core courses, 6 core practicals,1 project in the area of core, 8 complementary courses, 2 complementary practicals otherwise specified, from the relevant subjects for complementing the core of study. There should be 10 common courses, or otherwise specified, which includes the first and second language of study.

PROGRAMME STRUCTURE

MODEL I B.Sc. CHEMISTRY

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, Choice based course and Complementary courses including Project	79
F	Credits required from Open Course	3

COURSES

The programme (Model I) consists of Common courses with 38 credits, Core course, Choice based course, and Complementary courses with 79 credits and open course with 3 credits.

SCHEMES OF COURSES

The different types of courses and its number is as follows:

Courses	**Number**
Common Courses	10
Core Courses (Theory)	12
Project/ Industrial Visit and Comprehensive viva	1
Core Courses (practicals)	6
Open Course	1
Choice based Core Course	1
Complementary Courses (Theory)	8
Complementary Courses (Practicals)	2
Total	**41**

COURSES WITH CREDITS

Courses	**Credits**
Core Courses	46
Open Course	3
Choice Based Core Course	3
Project / I.V and Viva	2
Total	**54**
Complementary Courses I	14
Complementary Courses II	14
Total	**28**
Common Courses	38
Total	**38**
Grand Total	**120**

SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS FOR CORE COURSES

Semester	Theory	Practical
First	2	2
Second	2	2
Third	3	2
Fourth	3	2
Fifth	15	10
Sixth	15	10

COURSE CODE FORMAT

The programme is coded according to the following criteria.

1. The first letter plus second letter from the name of the programmeie., **CH**
2. One digit to indicate the semester. i.e., **CH1 (Chemistry, 1st semester)**
3. One letter from the type of courses such as, **A** for common course, **B** for Complementary course, **C** for Core course, **D** for Open course,ie.., **CH1C (Chemistry, 1st semester Core course)** and **PR** for project and **I** for Internship.
4. Two digits to indicate the course number of that semester. ie., **CH1C01 (Chemistry, 1st semester, Core course, course number is 01)**
5. The letter **B** to indicate Bachelors Programme.
6. **CH1C01B** (Chemistry, 1st semester, Core course, courses number 01, and **B** for bachelors Programme)
7. **23 to indicate the year.**ie., **CH1C01B23**
8. The letter **P** denotes practical – it should come after the code letter for the course ie., **CP** (core practical- eg.**CH1CP01B23**) / B**P**(complementary practical- eg.**CH1BP01B23**)
9. The letter **PR** denotes project, Project: **CH6PRB23**

DURATION OF PROGRAMME

- The duration of U.G. Programmes shall be **6 semesters**.
- 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.
- **Attendance**: Students having a minimum of 75% average attendance for all the courses only, can register for the examination.

STRUCTURE OF THE PROGRAMME

Bachelor's Programme in Chemistry- Model I

Sem	Course type	Course code	Course Title	Hrs/ week	Credits	Max Marks	
						ISA	ESA
I	**Common course I**	EN1A01B23	Fine Tune Your English	5	4	20	80
		EN1A02B23	Pearls From The Deep	4	3	20	80
	Common course II	MA1A01B23	Kathasahithyam	4	4	20	80
		HN1A01B23	Kahaani Aur Upanyas			20	80
		FR1A01B23	French Language And Communicative Skills -I			20	80
	Complementary course I	MT1B01B23	Differential And Integral Calculus	4	3	20	80
	Complementary course II	PH1B02B23	Properties Of Matter and Thermodynamics	2	2	15	60
	Complementary Practical	PH2BP02B23	Practical I	2	-	-	-
	Core course	CH1C01B23	General And Analytical Chemistry	2	2	15	60
	Core Practical	CH2CP01B23	Volumetric Analysis	2	-	-	-
	Total Credits			-	**18**	-	-
II	**Common course I**	EN2A03B23	Issues That Matter	5	4	20	80
		EN2A04B23	Savouring The Classics	4	3	20	80
	Common course II	MA2A03B23	Kavitha	4	4	20	80
		HN2A03B23	Kavitha Vyakaran Aur Anuvad			20	80
		FR2A03B23	French Language And Communicative Skills-II			20	80
	Complementary course I	MT2B01B23	Partial Derivatives, Multiple Integrals Trigonometry And Matrices	4	3	20	80
	Complementary course II	PH2B02B23	Mechanics And Crystallography	2	2	15	60

	Complementary Practical	PH2BP02B23	Practical I	2	2	10	40
	Core course	CH2C02B23	Theoretical And Inorganic Chemistry	2	2	15	60
	Core Practical	CH2CP01B23	Volumetric Analysis	2	2	10	40
			Total Credits	-	**22**	-	-
III	**Common course I**	EN3A05B23	Literature And/As Identity	5	4	20	80
	Common course II	MA3A05B23	Drisyakalasahithyam	5	4	20	80
		HN3A05B23	Naatak Aur Lambi Kavita			20	80
		FR3A05B23	An Advanced Course In French –I			20	80
	Complementary course I	MT3B01B23	Vector Calculus, Differential Equations And Analytic Geometry	5	4	20	80
	Complementary course II	PH3B02B23	Modern Physics And Basic Electronics	3	3	15	60
	Complementary Practical	PH4BP02B23	Practical II	2	-	-	-
	Core course	CH3C03B23	Organic Chemistry – I	3	3	15	60
	Core Practical	CH4CP02B23	Qualitative Organic Analysis (Micro)	2	-	-	-
			Total Credits	-	**18**	-	-
IV	**Common course I**	EN4A06B23	Illuminations	5	4	20	80
	Common course II	MA4A06B23	Malayala Gadhyarachanakal	5	4	20	80
		HN4A06B23	Gadya Aur Ekanki			20	80
		FR4A06B23	An Advanced Course In French –II			20	80
	Complementary course I	MT4B01B23	Fourier Series , Partial Differential Equations, Numerical Analysis And Abstract Algebra	5	4	20	80

	Complementary course II	PH4B02B23	Physical Optics, Laser Physics And Superconductivity	3	3	15	60
	Complementary Practical	PH4BP02B23	Practical II	2	2	10	40
	Core course	CH4C04B23	Organic Chemistry –II	3	3	15	60
	Core Practical	CH4CP02B23	Qualitative Organic Analysis	2	2	10	40
			Total Credits	-	**22**	-	-
V	**Core course**	CH5C05B23	Environmental Studies And Human Rights	4	4	15	60
		CH5C06B23	Organic Chemistry - III	3	3	15	60
		CH5C07B23	Physical Chemistry - I	2	2	15	60
		CH5C08B23	Physical Chemistry – II	2	3	15	60
	Open course	Offered By Other Departments	-	4	3	20	80
	Core Practical	CH6CP03B23	Qualitative Inorganic Micro Analysis	3	-	-	-
		CH6CP04B23	Organic Preparations And Laboratory Techniques	2	-	-	-
		CH6CP05B23	Physical Chemistry Practicals	3	-	-	-
	Project	CH6PRB23	Project	2	-	-	-
			Total Credits	-	**15**	-	-
VI	**Core course**	CH6C09B23	Inorganic Chemistry	3	3	15	60
		CH6C10B23	Organic Chemistry - IV	3	3	15	60
		CH6C11B23	Physical Chemistry – III	3	3	15	60
		CH6C12B23	Physical Chemistry – IV	3	3	15	60
		CH6C13aB23	Choice Based Core Course	3	3	20	80

	Core Practical	CH6CP03B23	Qualitative Inorganic Micro Analysis	3	2	10	40
		CH6CP04B23	Organic Preparations And Laboratory Techniques	2	2	10	40
		CH6CP05B23	Physical Chemistry Practicals	3	2	10	40
		CH6CP06B23	Gravimetric Analysis	2	2	10	40
	Project	CH6PRB23	Project	-	2	20	80
			Total Credits	-	**25**	-	-

Total credits of the programme = 120

CONSOLIDATED SCHEME FOR
I TO VI SEMESTERS CORE COURSES

B.Sc. CHEMISTRY PROGRAMME (MODEL - I)

Course Code	Title of the Course	Category	Hrs per week	Credits
SEMESTER-1				
CH1C01B23	General And Analytical Chemistry	Core	2	2
CH2CP01B23	Volumetric Analysis	Core	2	-
	Total Credits		**2**	
SEMESTER-2				
CH2C02B23	Theoretical And Inorganic Chemistry	Core	2	2
CH2CP01B23	Volumetric Analysis	Core	2	2
	Total Credits		**4**	
SEMSTER-3				
CH3C03B23	Organic Chemistry – I	Core	3	3
CH4CP02B23	Qualitative Organic Analysis (Micro)	Core	2	-
	Total credits		**3**	
SEMESTER-4				
CH4C04B23	Organic Chemistry –II	Core	3	3
CH4CP02B23	Qualitative Organic Analysis (Micro)	Core	2	2
	Total Credits		**5**	
SEMESTER-5				
CH5C05B23	Environmental Studies And Human Rights	Core	4	4
CH5C06B23	Organic Chemistry – III	Core	3	3
CH5C07B23	Physical Chemistry - I	Core	2	2
CH5C08B23	Physical Chemistry – II	Core	2	3
Offered by other departments	Open Course	Open	4	3
CH6CP03B23	Qualitative Inorganic Micro Analysis	Core	3	-
CH6CP04B23	Organic Preparations And Laboratory Techniques	Core	2	-
CH6CP05B23	Physical Chemistry Practicals	Core	3	-
CH6PRB23	Project	Core	2	-
	Total Credits		**15**	
SEMESTER-6				
CH6C09B23	Inorganic Chemistry	Core	3	3
CH6C10B23	Organic Chemistry – IV	Core	3	3
CH6C11B23	Physical Chemistry – III	Core	3	3
CH6C12B23	Physical Chemistry – IV	Core	3	3
CH6C13aB23	Choice Based Course	Core	3	3
CH6CP03B23	Qualitative Inorganic Micro Analysis	Core	3	2
CH6CP04B23	Organic Preparations And Laboratory Techniques	Core	2	2
CH6CP05B23	Physical Chemistry Practicals	Core	3	2

CH6CP06B23	Gravimetric Analysis	Core	2	2
CH6PRB23	Project	Core	-	2
	Total Credits	**25**		

OPEN COURSES

Sl. No.	Semester	Course Code	Course Title
1	V	CH5D01AB23	Chemistry In Everyday Life
2	V	CH5D01BB23	Nanoscience And Nanotechnology
3	V	CH5D01CB23	Forensic Science

CHOICE BASED CORE COURSES

Sl. No.	Semester	Course Code	Course Title
1	VI	CH6C13AB23	Nanochemistry And Nanotechnology
2	VI	CH6C13BB23	Polymer Chemistry
3	VI	CH6C13CB23	Soil And Agricultural Chemistry

COMPLEMENTARY COURSES OFFERED BY THE DEPARTMENT

[For Bachelor programme in Botany, Zoology, Home Science as Core]

Theory & Practical

Course Code	Title of the Course	Hrs per week	Credits
SEMESTER 1			
CH1B01B23	Basic Theoretical And Analytical Chemistry	2	2
CH2BP01B23	Volumetric Analysis	2	-
SEMESTER II			
CH2B01B23	Basic Organic Chemistry	2	2
CH2BP01B23	Volumetric Analysis	2	2
SEMESTER III			
CH3B01B23	Inorganic And Organic Chemistry	3	3
CH4BP01B23	Organic Chemistry Practicals (Micro)	2	-
SEMESTER IV			
CH4B01B23	Advanced Bio-Organic Chemistry	3	3
CH4BP01B23	Organic Chemistry Practicals (Micro)	2	2

EXAMINATIONS

The external theory examination of all semesters shall be conducted by the College at the end of each semester. Internal evaluation is to be done by continuous assessment.

Examinations have two parts: Internal or In-Semester Assessment (ISA) & External or End–Semester Assessment (ESA). The ratio between ISA and ESA shall be 1:4. Both internal and external marks are to be rounded to the next integer.

MARKS DISTRIBUTION FOR END-SEMESTER ASSESSMENT (ESA) AND IN-SEMESTER ASSESSMENT (ISA)

Marks distribution for ESA and ISA and the components for internal evaluation with their marks are shown below:
Components of the internal evaluation and their marks are as below.

For all courses without practical

a) End–Semester Assessment (ESA): 80 marks
b) In-Semester Assessment (ISA): 20 marks

ISA - Theory	Marks
Attendance	**5**
***Assignment**	**5**
Test papers (2 × 5)	**10**
Total	**20**

Attendance:

Percentage of Attendance	Marks
Above or equal to 90%	**5**
Above or equal to 85% but less than 90%	**4**
Above or equal to 80% but less than 85%	**3**
Above 75% but less than 80%	**2**
75 %	**1**
Less than 75%	**0**

For all courses with practical

a) End–Semester Assessment (ESA): 60 marks
b) In-Semester Assessment (ISA): 15 marks

ISA - Theory	Marks
Attendance	**5**
***Assignment**	**2**
Test papers (2 × 4)	**8**
Total	**15**

FOR ALL PRACTICAL PAPERS (conducted only at the end of even semesters):

(a) End Semester Assessment (ESA): 40
(b) In-Semester Assessment (ISA): 10

ISA components	Marks
Attendance	**2**
Test paper (1 × 4)	**4**
Record**	**4**
Total	**10**

** Marks awarded for Record should be related to number of experiments recorded.

FOR PROJECTS/ INDUSTRIAL VISIT AND COMPREHENSIVE VIVA-VOCE:

(a) End–Semester Assessment (ESA): 80
(b) In-Semester Assessment (ISA): 20

Components of Project/I.V. and Viva – ESA	Marks
Dissertation (External)	50
Comprehensive Viva-voce (External)	30
Total	**80**

Bonafide reports of the project work or Industrial Visit conducted shall be submitted at the time of examination. Projects which are preferably socially relevant/industry oriented/research priented are to be undertaken by the students and the reports have to be submitted.

All the four components of the ISA are mandatory.

Components of Project/ I.V. - ISA	Marks
Punctuality	5
Experimentation / Data Collection	5
Knowledge	5
Report	5
Total	**20**

ASSIGNMENTS

(i) *Assignment (project/field work/ Industrial Visit) for Semester I & II- to be given by language teachers, report of which has to be submitted and for those programmes which do not have additional language the students must undertake the assignment (project/field work/ Industrial Visit) for any one core paper.

(ii) *Assignment: for core papers (III & IV Semester), the student must undertake a Project/ Field work/ Industrial Visit/ Internship and the report of the same should be submitted for evaluation. The marks awarded to this can be considered for assignment of any one core paper.

IN-SEMESTER ASSESSMENT- TEST PAPERS

Two internal test- papers are to be attended in each semester for each paper. The evaluations of all components are to be published and are to be acknowledged by the students. All documents of internal assessments are to be kept in the college for two years. The responsibility of evaluating internal assessment is vested on the teachers who teach the course.

END- SEMESTER ASSESSMENT

The End-Semester examination of all courses shall be conducted by the College at the close of each semester. For reappearance/ improvement, students can appear along with the next batch.

PATTERN OF 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.

For each course the End-semester Assessment is of 3 hours duration. The question paper has 3 parts. Part A contains 12 short answer questions of which 10 are to be answered. Part B contains 9 short essay questions of which 6 are to be answered. Part C has 4 long essay questions of which 2 are to be answered.

Part	No. of Questions	No. of questions to be answered	Marks (For courses with practical)	Marks (For courses without practical)
A (Short Answer)	12	10	10 × 1 = 10	10 × 2 = 20
B (Short Essay)	9	6	6 × 5 = 30	6 × 5 = 30
C (Long Essay)	4	2	2 × 10 =20	2 × 15 = 30

CONDUCT OF PRACTICAL EXAMINATIONS

Practical examinations will be conducted only at the end of even semesters for all programmes.

PATTERN OF QUESTION PAPERS

Pattern of questions for end-semester assessment of practical papers will be decided by the concerned Board of practical examination.

GRADES

A 10- point scale based on the total percentage of marks (ISA + ESA) for all courses (theory, practical, project)

% of marks	Grade	Grade point
Equal to 95 and above	S - Outstanding	10
Equal to 85 and < 95	A^+ - Excellent	9
Equal to75 and < 85	A - Very good	8
Equal to 65 and < 75	B^+ - Good	7
Equal to 55 and < 65	B - Above average	6
Equal to 45 and < 55	C - Satisfactory	5
Equal to 35 and < 45	D - Pass	4
Below 35	F - Failure	0
	Ab - Absent	0

PASS CRITERIA

1. A separate minimum of 30% marks each for ISA and ESA (for both theory and practical) and aggregate minimum of 35% is required for a pass in a course.
2. For a pass in a programme, a separate minimum of Grade D is required for all the individual courses.
3. If a candidate secures F Grade for any one of the courses in a semester/programme, only F grade will be awarded for that semester/programme until she improves this to D Grade or above within the permitted period.
4. Students who complete the programme with D grade will have one betterment chance within 12 months, immediately after the publication of the result of the whole programme.

CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a course is calculated:

$CP = C \times GP$

C = Credit; GP = Grade point

Semester Credit Point Average (SCPA) of a semester:

SCPA = TCP/TC

TCP = Total Credit Point of that semester

TC = Total Credit of that semester

Cumulative Credit Point Average (CCPA) is calculated:

CCPA = TCP/TC

TCP = Total Credit Point of that programme

TC = Total Credit of that programme

CREDIT POINT AVERAGE (CPA)

Credit Point Average (CPA) of different category of courses viz. Common courses, Complementary courses, Core courses etc. are calculated:

CPA = TCP/TC

TCP = Total Credit Point of a category of course

TC = Total Credit of that category of course

Grades for the different courses, semesters and overall programme are given based on the corresponding CPA.

CPA	Grade
Equal to 9.5 and above	**S - Outstanding**
Equal to 8.5 and <9.5	**A^+ - Excellent**
Equal to 7.5 and < 8.5	**A - Very good**
Equal to 6.5 and < 7.5	**B^+ - Good**
Equal to 5.5 < 6.5	**B - Above average**
Equal to 4.5 and <5.5	**C - Satisfactory**
Equal to 4and < 4.5	**D - Pass**
Below 4	**F - Failure**

- ✓ For reappearance/improvement of I, II, III & IV semesters, candidate have to appear along with the next batch.
- ✓ There will be supplementary exams for V semester in the respective academic year.
- ✓ Notionally registered candidates can also apply for the said supplementary examinations.
- ✓ A student who registers her name for the end semester assessment for a semester will be eligible for promotion to the next semester.
- ✓ 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.
- ✓ A candidate who has not secured minimum marks/credits in ISA can re-do the same registering along with the ESA for the same semester, subsequently.
- ✓ There shall be no improvement for internal evaluation.
- ✓ All rules and regulations are subject to change as and when modified by Mahatma Gandhi University to which St. Teresa's College (Autonomous) is affiliated.

SYLLABI FOR CORE COURSES

SYLLABI FOR CORE COURSES

SEMESTER I

CORE COURSE
CH1C01B23: GENERAL AND ANALYTICAL CHEMISTRY

Credits: 2

Hours per week: 2 **Total Lecture Hours: 36**

Course Overview and Context:

The Course seeks to introduce Chemistry as a discipline of science, to refresh the basic concepts of Chemistry so that the students have a sound foundation as they move to advanced level of chemistry during the study of the programme. It also aims to create awareness about the various analytical and synthetic methodologies in Chemistry.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes:

CO1: Compute the number of significant digits, mean and standard deviation, percentage and distribution of errors from a set of analytical data and the molecular mass, molarity, oxidation and reduction numbers, equivalent mass. (**Apply**)

CO2: Explain the methodology of chemistry, components of a research project and the periodic properties of elements (**Understand**)

CO3: Illustrate the principles of analytical chemistry in the intergroup separation of cations, methods of expressing concentration, quantification of analytes by titrimetry, gravimetry and separation of organic compounds (**Apply**)

CO4: Differentiate between column chromatography, TLC, GC, Ion exchange chromatography and HPLC (**Understand**)

Syllabus Content

Module I: Methodology of Chemistry and Evaluation of Analytical Data(12 Hrs)

Definition of Science. Scientific statements, Scientific methods - observation-posing a question - formulation of hypothesis- experiment – theory - law. - revision of scientific theories and laws.

Evolution of Chemistry-ancient speculation on the nature of matter. Early form of chemistry-alchemy, origin of modern chemistry-branches of chemistry. Components of a research project -Introduction, review of literature, scope, materials and methods, results and discussion, conclusions and bibliography.

Evaluation of Analytical Data: Precision and accuracy-types of errors absolute and relative error (add) – ways of expressing precision- mean, median, standard deviation, average deviation and coefficient of variation, problems– ways to reduce systematic errors.

Module II: Periodic Table and Properties (6 Hrs)

Modern periodic law – Long form periodic table. Diagonal relationship and anomalous behavior of first element in a group. Periodicity in properties: Atomic and ionic radii - ionization enthalpy - electron affinity (electron gain enthalpy) – electronegativity. Electronegativity scales: Pauling and Mullikan scales. Allred and Rochow scale. Effective nuclear charge – Slater rule and its applications.

Molecular mass - mole concept – molar volume. Oxidation and reduction – oxidation number and valency – variable valency - equivalent mass of oxidizing agent and reducing

agent using oxidation number concept.

Module III : Analytical Methods in Chemistry (18 Hrs)

Qualitative analysis: Applications of solubility product and common ion effect in the precipitation of cations. Principle of intergroup separation of cations. Interfering acid radicals and their elimination (oxalate, fluoride, borate and phosphate).

Titrimetric analysis - fundamental concepts. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm. and ppb. Primary and secondary standards, quantitative dilution – problems. Acid base titrations- titration curves – pH indicators. Double burette Titrations-Principal and Advantages. Redox titrations – titration curve –titrations involving MnO_4^- and $Cr_2O_7^{2-}$ - redox indicators. Complexometric titrations – EDTA titrations - titration curves – metal ion indicators. Gravimetric analysis: Unit operations in gravimetric analysis - illustrations using iron and barium estimation. Separation and purification techniques – filtration, crystallization and precipitation – fractional distillation, solvent extraction. (demonstration).

Chromatographic Methods: Column Chromatography: Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications. Thin Layer Chromatography: Principle, choice of adsorbent and solvent, preparation of Chromatoplates, Rf-values, (demonstration), significance of Rf values. Ion exchange chromatography: Principle and experimental techniques. Gas Chromatography: Principle and experimental techniques. High Performance Liquid Chromatography (HPLC): Principle and experimental techniques.

TEXTBOOK

1. Anu Gopinath, Chandradasan, General and Analytical Chemistry, Vishal Publishing Co., Delhi, Third Revised Edition, June 2020.

REFERENCES

1. J.A.Lee, Scientific Endeavour, Addison Wesley Longman
2. C.N.R.Rao, University General Chemistry, MacMillan India (Ltd.)
3. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, Fundamentals of Analytical Chemistry, 8th Edition, Brooks/Cole, Thomson Learning, Inc., USA, 2004.
4. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London, 2010.
5. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 31st Edition, Milestone Publishers and Distributors, New Delhi, 2013.
6. Satya Prakash, Advanced Inorganic Chemistry, Volume 1, 5th Edition, S. Chand and Sons, New Delhi, 2012.
7. 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.
8. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press, Hyderabad, 2009.

MODEL QUESTION PAPER

B.Sc. DEGREE(C.B.C.S. S.) EXAMINATION, NOVEMBER 2023
SEMESTER I - CORE COURSE FOR B.Sc. CHEMISTRY
CH1C01B23: GENERAL AND ANALYTICAL CHEMISTRY

Time: 3 hrs **Maximum marks: 60**

Part A
(Answer any ten questions. Each question carries 1 mark)

Qn.No.	Questions	CO	Levels of question
1.	Identify the scientific method used in Western countries during the time of renaissance.	**1**	**U**
2.	Round 854000 to three significant digits.	**1**	**U**
3.	Identify the mode- 5,5,6,7, 6,4,8.	**1**	**U**
4.	The actual mass of an object is 300 g. A student records the mass of the object as 296.3 g. Compute his percent error?	**1**	**Ap**
5.	Cite the element with highest electronegativity.	**2**	**U**
6.	Order O, N, S in the increasing order of ionization energy.	**2**	**U**
7.	Recall the electronegativity of Fluorine in Pauling's scale.	**2**	**R**
8.	Identify the form in which the cations of group five are precipitated during intergroup separation.	**3**	**U**
9.	Calculate volume of 10M HCl which should be diluted with water to prepare 2 litres of 5M HCl.	**3**	**Ap**
10.	Identify an indicator used in weak acid-weak base titration.	**3**	**U**
11.	Differentiate between GSC and GLC.	**4**	**U**
12.	List any two applications of column chromatography	**4**	**R**

(10 × 1 = 10 marks)

Part B
(Answer any six questions. Each question carries 5 marks)

Qn.No.	Questions	CO	Level of question
13	Differentiate between inductive and deductive reasoning.	**1**	**U**
14	Explain the features of a scientific statement.	**1**	**Ap**
15	Explain Pauling's scale of electronegativity.	**2**	**U**
16	Define effective nuclear charge. Explain Slater's rules to find effective nuclear charge.	**2**	**U**
17	Explain the terms valency and oxidation number. d-block elements have variable oxidation states. Describe.	**2**	**U**
18	Calculate the solubility product of AgCl, provided that the solubility of AgCl in water is 0.00179g/l.	**3**	**Ap**
19	Explain the various terms used to express concentration.	**3**	**Ap**
20	Describe thin layer chromatography. Enumerate its applications.	**4**	**U**
21	With the aid of a suitable diagram, explain the experimental set up of gas chromatography.	**4**	**U**

(6 × 5 = 30 marks)

Part C
(Answer any two questions. Each question carries 10 marks)

Qn.No.	Questions	CO	Level of question
22	Explain the interdisciplinary areas involving chemistry.	**1**	**Ap**
23	Explain the methods of detection and minimization of systematic errors.	**1**	**Ap**
24	Illustrate the use of solubility product and common ion effect in inorganic qualitative analysis.	**3**	**Ap**
25	Describe the principle and experimental techniques involved in High Pressure Liquid Chromatography	**4**	**U**

(2 × 10 = 20 marks)

CO : Course Outcomes
Level : R – Remember, U – Understand, Ap- Apply, An- Analyze, E- Evaluate, C- Create

SEMESTER II

CORE COURSE

CH2C02B23: THEORETICAL AND INORGANIC CHEMISTRY

Credits - 2

Hours per week: 2 **Total Lecture Hours: 36**

Course Overview and Context:

To familiarize various theories of atomic structure, quantum numbers and their significance. The course also gives an introduction to chemical bonding and explains VB and MO theory. It also aims to create awareness about the chemistry of s, p, d and f block elements.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes

CO1: Apply the knowledge of atomic theories in recognizing the atomic spectra, wave particle dualities, Heisenberg's uncertainty principle and quantum numbers. (**Apply**)

CO2: Explain the properties of s and p block elements, transition metals and lanthanides. (**Understand**)

CO3: Explain the properties of ionic bond and ionic solids, calculation of lattice energy of ionic solids from Born-Lande equation and Born-Haber cycle, features of intermolecular forces and theories of metallic bond. (**Understand**)

CO4: Illustrate the covalent bonding in molecules using Valence Bond Theory, Resonance concept, Hybridization, VSEPR theory and Molecular Orbital theory. **(Apply)**

Syllabus Content

Module I : Atomic Structure(6 Hrs)

Failure of classical physics – black body radiation - Compton Effect (add). Planck's quantum hypothesis - photoelectric effect - generalization of quantum theory. 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 - Rydberg equation. limitations of Bohr theory. Sommerfeld's modification (add). Louis de Broglie's matter waves – wave-particle duality - electron diffraction - Davisson and Germer experiment Heisenberg's uncertainty principle.

Module II : Chemistry of d and f Block Elements (10 Hrs)

Transition Metals: General characteristics: Metallic character, oxidation states, size, density,melting points, boiling points, ionization energy, colour, magnetic properties, reducing properties, catalytic properties, non-stoichiometric compounds, complex formation and alloy formation. Difference between first row and other two rows. Preparation, properties, structure and uses of $KMnO_4$,$K_2Cr_2O_7$, $K_4Fe(CN)_6$, $PtCl_4$, Cu_2O, CrO_2Cl_2.

Lanthanides: Electronic configuration and general characteristics – Occurrence oflanthanides. Isolation of lanthanides from monazite sand - Separation by ion exchange method. Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides.

Module III : Chemical Bonding (20 Hrs)

Introduction – Octet rule and its limitations. Types of bonds: Ionic bond - factors favouringthe formation of ionic bonds - lattice energy of ionic compounds - Born- Lande

equation with derivation - solvation enthalpy and solubility of ionic compounds – Born-Haber cycle and its applications – properties of ionic compounds - polarisation of ions – Fajan's rule and its applications.

Covalent Bond: Valence Bond Theory and its limitations. Concept of resonance - resonance

structures of borate, carbonate and nitrate ions. Hybridization: Definition and characteristics

VSEPR theory: Postulates - applications - shapes of molecules NH_3, H_2O, XeF_2, IF_5, and XeF_6.

sp ($BeCl_2$, C_2H_2), sp^2 (BF_3, C_2H_4), sp^3 (CH_4, CCl_4, NH_3, H_2O, NH_4^+, H_3O^+ and SO_4^{2-}), sp^3d (PCl_5, SF_4, ClF_3, XeF_2), sp^3d^2 (SF_6, IF_5, XeF_4) and sp^3d^3 (IF_7, XeF_6) (add)

Properties of covalent compounds - polarity of bonds – percentage of ionic character – dipole moment and molecular structure.

Covalent Bond: 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-} . Metallic

Bond: free electron theory, valence bond theory and band theory (qualitative treatment only) - explanation of metallic properties based on these theories.

Intermolecular forces: Hydrogen bond - intra and inter molecular hydrogen bonds – effect on physical properties. Van der Waals forces, ion-dipole, dipole-dipole, ion-induced dipole, dipole-induced dipole and induced dipole-induced dipole interactions

Industry visit

TEXT BOOK

1. Anu Gopinath, Chandradasan, Theoretical and Inorganic Chemistry, Vishal Publishing House, Delhi, Revised Edition 2020.

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1. R.K. Prasad, *Quantum Chemistry*, New Age International, 2001
2. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach, Viva Books.
3. I. N. Levine, *Physical Chemistry*, Tata McGraw Hill,
4. ManasChanda, Atomic structure and Chemical bonding in Molecular Spectroscopy"Tata McGraw Hill.
5. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London.
6. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
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8. B. Douglas, D. Mc Daniel, J. Alexander, Concepts and models in Inorganic Chemistry.
9. Satya Prakash, *Advanced Inorganic Chemistry*, *Volume 1*, 5th Edition, S. Chand and Sons, New Delhi, 2012.
10. R. Gopalan, *Inorganic Chemistry for Undergraduates*, Universities Press, Hyderabad, 2009.

SEMESTER I AND II

CORE CHEMISTRY

CH2CP01B23- VOLUMETRIC ANALYSIS

Credits: 2

Hours per week: 2 **Total Hours: 72**

Course Overview and Context:

The course gives hands on training in weighing and preparation of standard solutions, estimation of analyte using acidimetry, alkalimetry, permanganometry, dichrometry–iodimetry, iodometry- and complexometriy.

The Course enables students to acquire skills in chemical analysis through volumetric titrations.The course enhances the job opportunities of students as chemical analysts.

The course generates environmental consciousness in students by introducing them to microanalysis where reduced amounts of chemicals are used for analysis and hence pollution due to drainage of chemicals is greatly reduced.

Course Outcomes:

CO1: Prepare standard solutions for microscale volumetric analysis. **(Apply)**

CO2: Record the molarity of the given intermediate solution by standardizing it. **(Apply)**

CO3: Calculate the mass of the analyte in a given solution by microscale volumetric analysis. **(Apply)**

CO4: Administer microscale analysis of solutions by different types of volumetry like acidimetry, alkalimetry, complexometry, permanganometry, dichrometry, iodometry and iodimetry. **(Apply)**

Syllabus Content:

Selected experiments shall be done by double burette method

A. Acidimetry and Alkalimetry

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

B. Complexometric Titrations Using EDTA

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

C. Oxidation – Reduction Titrations

(i) Permanganometry

1. Estimation of ferrous iron

2. Estimation of oxalic acid
3. Estimation of sodium oxalate
4. Estimation of calcium

(ii) Dichrometry

1. Estimation of ferrous iron using internal indicator
2. Estimation of ferrous iron using external indicator
3. Estimation of ferric iron using internal indicator
4. Estimation of ferric iron using external indicator

(iii) Iodimetry and Iodometry

1. Estimation of copper
2. Estimation of arsenious oxide

TEXTBOOK

1. Saritha Chandran A, Sicily Rilu Joseph, Lab Manual on Microscale Volumetric Analysis For Core Chemistry, Teresian Publishing House, St. Teresa's College (Autonomous), Ernakulam Second edition 2021.

REFERENCES

1. A. I. Vogel 'A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis': (Third Ed.) (ELBS)
2. D.A.Skoog, D.M.West and S.R.Crouch, Fundamentals of Analytical Chemistry, 8thEdn., Brooks/Cole Nelson.
3. Vogels Textbook of Quantitative Chemical Analysis, 6thEdn., Pearson Education Ltd.

SEMESTER III

CORE COURSE

CH3C03B23: ORGANICCHEMISTRY – I

Credits – 3

Hours per week- 3 **Total Lecture Hours: 54**

(Reaction mechanisms expected only wherever mentioned)

Course Overview and Context

The Course seeks to introduce the topics in chemistry such as IUPAC nomenclature, reaction mechanism, stereochemistry, aryl and alkyl halides, aromaticity and hydrocarbons, which are essential basics for students who wish to pursue organic chemistry.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes:

CO1: Summarize the types of reagents and reactive intermediates, electronic displacement effects and reaction mechanisms in organic chemistry. (**Understand**)

CO2: Apply the knowledge of isomerism in predicting the nomenclature and stability of organic molecules. (**Apply**)

CO3: Generalize the preparation, properties and uses of alkanes, alkenes, alkynes, alkyl halides and aryl halides. (**Understand**)

CO4: Predict the aromaticity and reactivity of aromatic compounds towards Electrophilic substitution reactions. (**Apply**)

Syllabus Content

Module I : Fundamentals of Organic Chemistry (12 Hrs)

Classification and IUPAC system of nomenclature of common organic compounds (both aliphatic and aromatic).

Line diagram drawing. Factors affecting reaction mechanism. Polarity of bonds.

Electronic displacements: Inductive effect, electromeric effect, mesomeric effect, resonance and hyperconjugation. steric effects.

Cleavage of bonds: Homolysis and heterolysis with suitable examples. curly arrow rules, formal charges.

Types of reagents: Nucleophiles and electrophiles.

Reactive intermediates: Carbocations, carbanions, free radicals and carbenes – types, shape and relative stability.

Types of organic reactions: Addition, elimination, substitution, rearrangement and redox reactions (definition and one example each).

Pericyclic Reactions: Classification – electrocyclic reactions, cycloadditions - Diels-Alder reaction and Sigmatropic rearrangements - Claisen rearrangement (with mechanism).

Module II : Stereochemistry (15 Hrs)

Stereoisomerism – definition, classification.

Optical isomerism: Optical activity, specific rotation, concept of chirality (upto two carbon atoms). Configuration. Enantiomerism, diastereomerism and meso compounds. Racemic

mixture and methods of resolution. Asymmetric synthesis (partial and absolute). Threo and erythro; *d* and *l* designations; Cahn-Ingold-Prelog rules: R/ S notation (for upto 2 chiral carbon atoms).

Geometrical isomerism: cis–trans, syn-anti and E/Z nomenclature (for upto two C=C systems) with C.I.P rules. Methods of distinguishing geometrical isomers.

Conformational analysis: Conformational analysis with respect to ethane, butane and cyclohexane. Relative stability and energy diagrams. Interconversion of Wedge formula, Newman, Sawhorse and Fischer projection formulae. Chair, boat and twist boat forms of cyclohexane with energy diagrams. Conformation of methyl cyclohexane. Origin of ring strain in cyclic systems. Baeyer's strain theory.

Module III: Aliphatic Hydrocarbons and Alkyl Halides (12 Hrs)

Preparation – Alkane , alkene, alkyne and alkyl halides (Non-evaluative)

*Alkanes:*Reactions - catalytic hydrogenation, Wurtz reaction, Wurtz-Fittig reaction, from Grignard reagent. Reactions - free radical substitution - halogenation.

*Alkenes:*Reactions - Elimination reactions - mechanism of E1 and E2 reactions. Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's and Hofmann's rules). Reactions - *cis*-addition (alkaline $KMnO_4$) and *trans*-addition (bromine). Addition of HX (Markownikoff's and anti-Markownikoff's addition with mechanisms), Hydration, Ozonolysis.

*Alkynes:*Reactions- Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. Reactions - Acidity of alkynes, formation of metal acetylides, alkylation of terminal alkynes and conversion into higher alkynes, addition of bromine and alkaline $KMnO_4$.

*Alkyl Halides:*Reactions- Types of aliphatic nucleophilic substitution reactions - SN1and SN 2 mechanisms with stereochemical aspects and effects of substrate structure, solvent, nucleophile and leaving group

Organometallic compounds of Mg (*Grignard reagents*) – Formation, structure and important reactions/synthetic applications.

Module IV: Aromatic Hydrocarbons and Aryl Halides (15 Hrs)

*Aromaticity :*Definition, Hückel's rule - application to benzenoid (benzene, naphthalene and anthracene) and non-benzenoid (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation) compounds.

Benzene: Molecular orbital picture and resonance energy. Preparation - from phenol, by decarboxylation, from acetylene, from aromatic acids. Reactions - Electrophilic aromatic substitution: nitration, halogenation, sulphonation and Friedel-Craft's reaction (alkylation and acylation) with their mechanism. Orientation of aromatic substitution. *ortho, para* and *meta* directing effects of groups. Ring activating and deactivating groups with examples.

Naphthalene and Anthracene: Molecular orbital picture and resonance energy. Preparation(of Naphthalene): Haworth synthesis Reactions - Electrophilic substitutions (halogenation, nitration and sulphonation) of naphthalene.

Aryl Halides: Preparation - chloro, bromo and iodo-benzene from phenol, Sandmeyer and Gattermann reactions. Reactions - aromatic nucleophilic substitutions – bimolecular displacement mechanism, elimination-addition (benzyne intermediate) mechanism.

TEXT BOOKS

1. K. S. Tewari and N. K. Vishnoi, 'Organic Chemistry', 3rdEdition, VikasPublishingHouse, 2004.
2. Arun Bahl and B.S.Bahl 'A Text Book of Organic Chemistry'16th Edition, 2006.
3. Sharma, S. C., Gem Mathew, G. D., Ramachandran, P. R., Organic Chemistry-I, Vishal Publishing Co., 2020

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1. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry*, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
2. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons, 2014.
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4. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, 1988.
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8. Bahl, A. &Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
9. Kalsi, P. S. *Stereochemistry - Conformation and Mechanism*; New Age International, 2005.
10. Pillai, C.N. *Organic Chemistry*, Universities Press, 2008.
11. Gupta, S.S. *Organic Chemistry*, Oxford University Press, 2014.

SEMESTER IV

CORE COURSE

CH4C04B23: ORGANIC CHEMISTRY –II

Credits – 3

Hours per week: 3 **Total Lecture Hours: 54**

(Reaction mechanisms expected only wherever mentioned)

Course Overview and Context

The Course is intended to discuss in details about the chemistry of various classes of organic compounds in a systematic manner. Uses of various synthetic reagents and mechanisms of a number of named reactions are discussed.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes:

CO1: Illustrate the preparation, properties and reactions with mechanism of alcohols, phenols, ethers and epoxides. (**Apply**)

CO2: Summarize the preparation, properties and reactions with mechanism of aldehydes and ketones. (**Understand**)

CO3: Generalize the preparation, reactions and uses of carboxylic acids, sulphonic acids and their derivatives. (**Understand**)

CO4: Apply the knowledge of functional group chemistry in intergroup conversion and identification of products with mechanism. (**Apply**)

Syllabus Content

Module I : Alcohols, Phenols and Ethers (16 Hrs)

Alcohols: Preparation - 1, 2 and 3 alcohols using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acids and esters (Bouveault-Blanc reduction). Reactions - with sodium, HX (Lucas test), esterification, oxidation (with PCC, alkaline $KMnO_4$, OsO_4, acidic dichromate, conc. HNO_3. Oppenauer oxidation (with mechanism). Ascent and descent of alcohol series.

Diols: Preparation - hydroxylation of alkenes, hydrolysis of epoxides. Reactions - oxidative cleavage of diols using lead tetraacetate and periodic acid. Pinacol - Pinacolone rearrangement (with mechanism).

Phenols: Preparation -cumene hydroperoxide method, from diazonium salts. Reactions - Electrophilic substitution - nitration, halogenation and sulphonation. Reimer- Tiemann reaction and Fries rearrangement (with mechanisms). Preparation and uses of nitrophenols, picric acid, resorcinol and quinol.

Ethers and Epoxides: Preparation - ethers and epoxides - Williamson's ether synthesis. Reactions of ethers - cleavage with HI. Zeisel's method of estimation of alkoxy groups. Reactions of epoxides - with alcohols, ammonia derivatives and LiAlH 4.

Interconversions, tests for functional groups, synthetic road map problems.

Module II : Aldehydes and Ketones (20 Hrs)

Preparation, properties and reactions of formaldehye, acetaldehyde, acetone, benzaldehyde and benzophenone.

Preparation - from alcohols, acid chlorides, esters and nitriles. Reactions - Structure of the

Carbonyl group and acidity of alpha hydrogen. Addition reactions - with HCN, ROH, $NaHSO_3$, Grignard reagents and ammonia derivatives.

Reactions (with mechanism)- Aldol, Claisen, Claisen-Schmidt, Knoevenagel and Benzoin condensations, Cannizzaro reaction, Wittig reaction, Baeyer-Villiger oxidation, Reduction reactions - Clemmensen, Wolff-Kishner, Meerwein-Pondorff-Verley.

Reactions (No mechanism)- Mannich reaction, Michael addition. Oxidation reactions - Tollen's and Fehling's tests, Iodoform test. Reduction reactions - $LiAlH_4$, and $NaBH_4$ reductions. Rearrangement reactions - Beckmann, and benzil-benzilic acid rearrangements.

Interconversions, tests for functional groups, road map problems.

Module III : Carboxylic Acids, Sulphonic Acids and their Derivatives (12 Hrs)

Carboxylic acids (aliphatic and aromatic): Preparation - Oxidation of alcohols and aldehydes, hydrolysis of nitriles, side chain oxidation and carbonylation of grignard reagents. Acidic and alkaline hydrolysis of esters. Reactions - structure of carboxylate ion, effect of substituents on acid strength. Ascent and descent of acid series. Reduction and decarboxylation reactions. Reactions with PCl_5, PCl_3 and $SOCl_2$. Reaction with ammonia, esterification and halogentaion. Hell – Volhard - Zelinsky reaction (with mechanism).

Carboxylic acid derivatives (aliphatic): Preparation - acid chlorides, anhydrides, esters and amides from acids. Reactions - comparative study of nucleophilicity of acyl derivatives. Perkin condensation and Reformatsky reaction (with mechanisms).

Sulphonic acids and their derivatives: Preparation, reactions and uses of benzene sulphonic acid, benzene sulphonyl chloride and *ortho*- and *para*- toluene sulphonyl chlorides.

Interconversions, tests for functional groups, synthetic road map problems.

Module IV : Dicarboxylic acids and unsaturated acids (6 Hrs)

Methods of formation, important reactions and uses of dicarboxylic acids, hydroxy acids and unsaturated acids like oxalic acid, phthalic acid, citric acid, salicylic acid, cinnamic acid, maleic acid and fumaric acid.

Interconversions, tests for functional groups, synthetic road map problems.

Industry visit

TEXTBOOKS

1. K. S. Tewari and N. K. Vishnoi'Organic Chemistry', 3rdEdition, VikasPublishingHouse, 2004.
2. Arun Bahl and B.S.Bahl 'A Text Book of Organic Chemistry'16th Edition, 2006.
3. Sharma, S. C., Gem Mathew, G. D., Ramachandran, P. R., Organic Chemistry-II, Vishal Publishing Co., 2020.

REFERENCES

1. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry,* 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
2. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry,* Wiley, 2014.
3. McMurry, J. *Organic Chemistry*, 7th ed. Cengage Learning, 2013.
4. Finar, I.L. *Organic Chemistry* (Vol. 1), Dorling Kindersley (India) Pvt. Ltd (Pearson Education).
5. Carey, F.A., Giuliano, R.M. *Organic Chemistry,* 8th ed., Tata McGraw Hill,.2012
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.

8. Tewari, K.S. &Vishnoi, N.K. *Organic Chemistry*, Vikas Publishing House, 2012.
9. Pillai, C.N. *Organic Chemistry*, Universities Press, 2008.
10. Gupta, S.S. *Organic Chemistry*, Oxford University Press,

SEMESTER III AND IV

CORE COURSE

CH4CP02B23: QUALITATIVE ORGANICANALYSIS (MICRO)

Credit-2

Hours per week: 2 **Total Hours: 72**

Course Overview and Context

To analyze and confirm the functional groups after detecting the hetero atoms, saturation/unsaturation, aromatic/aliphatic and preparation of solid derivatives.The physical constants of the given compounds are also determined.

The course provides skill development in analysing various classes of organic compounds, which will be useful in the synthetic organic chemistry and pharmaceutical chemistry, nutritional chemistry.

Course Outcomes:

CO1: Record the physical constants of solid and liquid organic compounds. **(Apply)**

CO2: Determine the heteroatoms present in an organic compound.**(Apply)**

CO3: Determine the functional groups present in an organic compound. **(Apply)**

CO4: Prepare a solid derivative of the analyzed organic compound. **(Apply)**

Syllabus Content

1. Determination of physical constants of solids and liquids – melting and boiling points.
2. Tests for elements: Nitrogen, Halogens and Sulphur
3. Tests for unsaturation.
4. Tests for aromatic character.
5. Study of the reactions of the following functional groups: carboxylic acid, 1,2-dicarboxylic acid, phenol, aldehyde, ketone, ester, reducing and nonreducing sugars, polynuclear hydrocarbon, primary, secondary and tertiary amines, amides, diamide, nitro and halogen compounds.
6. Systematic analysis and preparation of solid derivative of the following organic compounds: carboxylic acid, 1,2-dicarboxylic acid, unsaturated acids, phenol,hydroxy acids, aldehyde, ketone, ester, reducing and nonreducing sugars, polynuclear hydrocarbon, primary, secondary and tertiary amines, amide, diamide, nitro and halogen compounds.

(Minimum twelve compounds to be analysed)

TEXT BOOK

1. Thomas, M., A Practical Book for Volumetric Analysis & Microscale Organic Compound Analysis, First Edition, April 2019

REFERENCES

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V. Smith, P.W.G.; Tatchell, A.R. *Vogel'sTextbook of Practical Organic Chemistry,* 5th ed., Pearson Education, 2005.
2. Mann,F.G.; Saunders, B.C. *Practical Organic Chemistry*, 4th ed., Pearson Education, 2009.
3. Ahluwalia, V.K.; Dhingra, S. *Comprehensive Practical Organic Chemistry –Qualitative Analysis*, Universities Press, 2000.
4. Vishnoi, N.K. *Advanced Practical Organic Chemistry*, 3rd ed., Vikas Publishing House, New Delhi, 2010.

SEMESTER V

CORE COURSE

CH5C05B23: ENVIRONMENTAL STUDIES AND HUMAN RIGHTS

Credits – 4

Hours per week: 4 **Total Lecture Hours: 72**

Course Overview and Context:

The Course is intended to discuss in details about theEcosystem, Natural resources like forest resources, mineral resources, energy resources, land resources, Air pollution, Water pollution, Soil Pollution, waste management and toxicological effects of chemicals.

The course provides training for employability as scientist/chemist/teacher.

The course introduces the importance of environmental sustainability and encourages the students to protect the environment. It also helps us to understand the social issues and Human Rights.

Course Outcomes:

CO1: Explain the principles of ecosystem and the use and over exploitation of natural resources. (**Understand**)

CO2: Explain various environmental acts in India and the need for public awareness. (**Understand**)

CO3: Identify and interpret the concept of Human Rights and its relevance for women, children and environment. (**Understand**)

CO4: Illustrate the causes, effects and control measures of industrial waste and environmental pollution with special reference to air, water, soil, nuclear, noise and thermal pollution. (**Apply**)

CO5: Apply the twelve principles of green chemistry in reducing the impact of pollution and toxic chemicals in the environment. (**Apply**)

Syllabus Content

Module I : Multidisciplinary Nature of Environmental Studies and Ecosystem(20 Hrs)

Definition, scope and importance. Need for public awareness. Natural resources: Renewable and non-renewable resources, forest resources - use and over-exploitation, deforestation. Water resources - use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources - use and exploitation, environmental effects of extracting and using mineral resources. Food resources - World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems. Energy resources -growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land resources - land as a resource, land degradation, man induced landslides, soil erosion and desertification

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the given ecosystem:- Forest ecosystem.

Module II : Social Issues, Human Rights and Environment (20 Hrs)

Urban problems related to energy. Water conservation, rain water harvesting, water shed

management. Resettlement and rehabilitation of people: its problems and concerns. Environmental ethics: Issues and possible solutions. Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act,

Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, public awareness.

An Introduction to Human Rights, meaning, concept and development. Three generations of human rights (civil and political rights; economic, social and cultural rights).Human Rights and United Nations – contributions, main human rights related organs - UNESCO,UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights. Human Rights in India: Fundamental rights and Indian Constitution,

Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities. Environment and Human Rights - right to clean environment and public safety. Issues of industrial pollution, prevention, rehabilitation and safety aspect of new technologies such as chemical and nuclear technologies, protection of environment.

Module III : Environmental Pollution (24 Hrs)

Air pollution: Causes, effects and control measures. Acid rain, smog, greenhouse effect,Global warming, ozone depletion – causes and consequences.

Water pollution: Water pollution- Eutrophication, Biomagnification, water quality parameters- DO, BOD, COD

Cause, effects and control measures of:- Soil Pollution, Nuclear Pollution, Noise Pollution and Thermal pollution.

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

Pollution case studies.

Introduction to green chemistry: twelve principles of green chemistry, atom economy – examples.

Module IV: Toxicology and Toxicological Effects (8 Hrs)

Toxic chemicals in the environment, impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, CO, Oxides of Nitrogen and Sulphur.

TEXTBOOK

1. Ushamani M, Sheela D, Priya K Nair, Saritha Chandran A, Swathy Varma P R, Environmental Studies, First edition, 2017, Teresian Publishing House, St. Teresa's College, Ernakulam

REFERENCES

1. BharuchaErach, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013 (TB)
2. Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)
3. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001 Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p .(Ref)
4. Dc A.K. Enviornmental Chemistry, Wiley Eastern Ltd.(Ref)
5. Down to Earth, Centre for Science and Environment (Ref)
6. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)
7. Jadhav.H & Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)

8. Mekinney, M.L &Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)
9. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB) Mahatma Gandhi University, Kottayam 32
10. Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p (Ref)
11. Rao.M.N&Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p (Ref)
12. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
13. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)
14. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)
15. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (Ref)
16. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref
17. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p (Ref)
18. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th Edition, New Age International (P) Ltd., New Delhi, 1995 (Reprint 2005).
19. S. Glasstone, Source Book on Atomic Energy, 3rd Edition, East-West Press Pvt. Ltd., New Delhi, 1967.
20. U.N. Dash, Nuclear Chemistry, Sultan Chand and Sons (1991).

SEMESTER V

CORE COURSE

CH5C06B23: ORGANIC CHEMISTRY - III

(Reaction mechanisms expected only wherever mentioned)

Credits – 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Context:

To familiarize students with nitro compounds, amines, diazonium salts heterocyclic compounds and compounds containing active methylene groups. Organic spectroscopy and different types of dyes, drugs and polymers are also discussed.

The course increases the job opportunities of students in all kinds of chemical and pharmaceutical industries where organic molecules and reactions are used. It provides training for employability as scientist/chemist/teacher.

Course Outcomes:

CO1: Illustrate the preparation, properties and reactions of Nitrogen containing compounds like Nitro, Amino, Diazonium salts and heterocyclics (**Apply**)

CO2: Summarize the preparation, properties and applications of active methylene compounds (**Understand**)

CO3: Demonstrate the principles and applications of spectroscopic methods used for the structure elucidation of organic molecules. (**Apply**)

CO4: Generalize the preparation, properties and applications of Drugs, Dyes and Polymers. (**Understand**)

Syllabus Content

Module 1: Nitrogen Containing Compounds (23 hrs)

Nitro compounds(aliphatic and aromatic): Preparation: Methods of preparation of nitroalkanes and aromatic nitro compounds**.**Reactions: Tautomerism of nitromethane. Reduction products of nitrobenzene in acidic,neutral and alkaline media. Electrolytic reduction and selective reduction of polynitro compounds. Formation of charge transfer complexes.

Amines(aliphatic and aromatic):Preparation: From alkyl halides, Reduction of nitro compounds and nitriles, Reductiveamination of aldehydes and ketones, Gabriel's phthalimide synthesis, Hofmann bromamide reaction (with mechanism).Reactions:Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2.Separation of a mixture of 1°, 2° and 3° amines using Hinsberg reagent. Stereochemistry of amines. Structural features affecting basicity of aliphatic and aromatic amines. Comparative study of aliphatic and aromatic amines. Schotten – Baumann Reaction (with mechanism). Electrophilic substitution reactions of aniline: Halogenation, nitration and sulphonation. Quaternary amine salts as phase-transfer catalysts.

*Diazonium salts:*Preparation:From aromatic amines.Reactions: Structure and stability of benzene diazonium salts. Conversion to benzene, phenol,chloro, bromo, iodo and fluoro benzenes, nitro benzene and azo dyes. Mechanisms of Sandmeyer and Gatterman reactions. Schiemann and Gomberg reactions.

Heterocyclic Compounds: Classification and nomenclature. Structure and aromaticity of 5-

numbered and 6-membered rings containing N as heteroatom. Synthesis and reactions of: Pyrrole (Paal-Knorr synthesis and Knorr pyrrole synthesis), Pyridine (Hantzsch synthesis),Indole (Fischer's indole synthesis), Quinoline (Skraup synthesis and Friedlander's synthesis) and Isoquinoline (Bischler-Napieralski reaction).

Module II : Active Methylene Compounds (5 Hrs)

Preparation: Ethyl acetoacetate by Claisen ester condensation.

Reactions: Keto-enol tautomerism. Synthetic uses of ethylacetoacetate, diethyl malonate andethyl cyanoacetate (preparation of non-heteromolecules only). Alkylation of carbonyl compounds *via* enamines.

Module III : Organic Spectroscopy (11 Hrs)

UV Spectroscopy: Types of electronic transitions,λmax, Chromophores and Auxochromes,Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ_{max} for the following systems: α,β-unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorptionpositions of O and N containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift andfactors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects inalkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.

Applications of IR, UV and NMR for identification of simple organic molecules.

Mass Spectrometry: Introduction. EI ionisation. Determination of molecular mass by MS(elementary idea only – fragmentation study not required).

Module IV: Drugs, Dyes and Polymers (15 Hrs)

*Drugs:*Classification of drugs. Structure, therapeutic uses and mode of action (synthesis not required) of Antibiotics: Ampicillin and Chloramphenicaol, Sulpha drugs: Sulphanilamide, Antipyretics: Paracetamol, Analgesics: Aspirin, Antimalarials: Chloroquine, Antacids: Ranitidine, Anti- cancer drugs: Chlorambucil and Anti-HIV agents: Azidothymidine (Zidovudine). Psychotropic drugs: Tranquilizers, antidepressants and stimulants with examples. Drug addiction and abuse. Prevention and treatment.

Dyes: Theories of colour and chemical constitution. Classification of dyes – according to chemical constitution and method of application. Natural and synthetic dyes.

Synthesis and applications of: Azo dyes – Methyl orange; Triphenyl methane dyes - Malachite green and Rosaniline; Phthalein dyes – Phenolphthalein and Fluorescein; Indigoid dyes - Indigotin; Anthraquinoid dyes – Alizarin.

*Polymers:*Introduction and classification. Polymerisation reactions - Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-basedZiegler-Natta polymerization of alkenes. Preparation and applications of plastics–thermosetting (Phenol-formaldehyde, Urea-formaldehyde) and thermosoftening (Polythene) Fibres (Polyamide, Polyester). Synthetic rubbers– SBR andNeoprene. Introduction to conducting polymers with examples. Environmental hazards and biodegradability of polymers. Recycling of plastics.

TEXTBOOKS

1. Sharma, Y. R, Chemistry of Natural Product and Biomolecules, Kalyani Publishers, 2011
2. Gem Mathew, G. D., Ramachandran P. R., Organic Chemistry-IV, Vishal Publishing Co., Vishal Publishing Co., January 2021

REFERENCES

1. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry*, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
2. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, Wiley, 2014.
3. McMurry, J. *Organic Chemistry*, 7th ed. Cengage Learning, 2013.
4. Finar, I.L. *Organic Chemistry* (Vol. 1 & 2), Dorling Kindersley (India) Pvt. Ltd (Pearson Education).
5. Jain, M.K. & Sharma, S.C. *Modern Organic Chemistry*, Vishal Publishing Co. 2010.
6. Bahl, A. &Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
7. John R. Dyer: Applications of Absorption Spectroscopy of Organic Compounds,Prentice Hall.
8. R.M. Silverstein, G.C. Bassler& T.C. Morrill*: Spectroscopic Identification ofOrganic Compounds*, Wiley.
9. Pillai, C.N. *Organic Chemistry*, Universities Press, 2008.
10. Gupta, S.S. *Organic Chemistry*, Oxford University Press, 2014.

SEMESTER V

CORE COURSE

CH5C07B23: PHYSICAL CHEMISTRY - I

Credits – 2

Hours per week: 2 **Total Lecture Hours: 36**

Course Overview and Context:

The course is intended to impart knowledge about the different states of matter, the behavior and general characteristics of the three states and to learn about different types of liquid crystals. It also discusses about the phenomena of an important physical process - adsorption which has wide chemical applications.

The course provides training for employability as scientist/chemist/teacher.

The courses help the students to develop skills in X-ray diffraction analysis and its interpretations and in determination of surface area using adsorption isotherms.

Course Outcomes

CO1: Apply the laws and properties of gaseous state in explaining Kinetic gas equation, van der Waals equation, Virial equation of state and the relation between critical constants and van der Waals constants. (**Apply**)

CO2: Apply the laws of crystallography and the theory of X-ray diffraction technique to identify the lattice type and the interplanar spacing and hence predict the crystal structure of sodium chloride and potassium chloride. (**Apply**)

CO3: Differentiate the different types of adsorptions, adsorption isotherms and liquid crystals. (**Understand**)

CO4: Explain the properties of colloids and determination of Surface tension and Viscosity of liquids. (**Understand**)

Syllabus Content

Module 1: Gaseous State (12 Hrs)

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena and Andrews isotherms of CO_2, critical constants and their calculation from van der Waals equation. Virial equation of state, van der Waals equation expressed in virial form.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphical representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation).

Collision properties: Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Relation between mean free path and coefficient of viscosity.

Module II: Solid State and Surface Chemistry (18 Hrs)

Solid State: The nature of the solid state – anisotropy –Forms of solids. Unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Defects in crystals – stoichiometric and non-stoichiometric defects, extrinsic and intrinsic defects. Electrical

conductivity, semiconductors, n-type, p-type (Non-evaluative).

Laws of Crystallography – Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Laue's method, Bragg's law. Bragg's X-ray diffractometer method and powder pattern method. Analysis of powder diffraction patterns of NaCl and KCl, density of cubic crystals, Calculation of N_0.

Structure of ionic compounds of the type AX (NaCl, CsCl, ZnS) and AX_2 (CaF_2, Na_2O, Structure of diamond), Packing of crystals- hcp, ccp packing, Voids- types, Packing efficiency, Radius ratio. Superconductivity – Introduction, Type I, II and Applications.

Liquid Crystals: Liquid crystals and its thermographic behaviour. Classification, structure of nematic and cholestric phases., Applications of Liquid crystals.

Surface Chemistry: Adsorption – types, adsorption of gases by solids – factors influencing adsorption (Non-evaluative)

Isotherms: Freundlich adsorption isotherm, Limitations – Langmuir adsorption isotherm – derivation of Langmuir adsorption isotherm, Limitations. The BET theory (no derivation) – use of BET equation for the determination of surface area, Problems based on surface area. Gibbs Adsorption Isotherm (no derivation). Applications of adsorption.

Module III: Liquid State and Colloids (6 Hrs)

Liquid State: Intermolecular forces in liquids (qualitative idea only). Surface tension and its measurement by stalagmometer method, factors affecting Surface tension, Viscosity, Poisuelle's equation, Determination of viscosity by Ostwald's viscometer.

Colloidal State: Purification of colloids – Ultra filtration and electrodialysis, optical and electrical properties of colloids. Electrical double layer. Coagulation of colloids, Hardy-Schulz rule. Micelles and critical micelle concentration (elementary idea).

TEXTBOOK

1. Gokulachandran, T. M., Thomas, J. K, States of Matter, Manjusha Publications, First Edition, May 2014.

REFERENCES

1. R P W Atkins, *"Physical Chemistry"*, Oxford University Press
2. R J Silby and R AAlberty, *"Physical Chemistry"*, John Wiley & Sons
3. F Daniels and A Alberty, *"Physical Chemistry"*, Wiley Eastern
4. Puri, Sharma and Pathania, *"Principles of Physical Chemistry"*, Millennium Edition, Vishal Publishing Co.
5. Barrow, G.M. "*Physical Chemistry"*,Tata McGraw-Hill (2007).
6. Castellan, G.W. "*Physical Chemistry"*,4th Ed. Narosa (2004).
7. K. L. Kapoor, "*A Textbook of Physical chemistry"*, Volume 1, Macmillan India Ltd.,
8. B. R. Puri, L. R. Sharma, M. S. Pathania, "*Elements of Physical chemistry"*, Vishal Pub. Co.,
9. L V Azaroff, *"Introduction to Solids"*, McGraw Hill.
10. N B Hannay, *"Solid State Chemistry"*, Prentice Hall.
11. A. McQuarrie, J. D. Simon, *"Physical Chemistry – A molecular Approach"*, Viva Books Pvt. Ltd.
12. Anthony R. West, "Solid State Chemistry and its Applications", Wiley Eastern.

SEMESTER V

CORE COURSE

CH5C08B23: PHYSICAL CHEMISTRY – II

Credits - 3

Hours per week: 2 **Total Lecture Hours: 36**

Course Overview and Context:

The course gives an introduction to quantum mechanics and its applications, spectroscopic techniques like rotational, vibrational, electronic and NMR, and the concepts in molecular symmetry.

The course develops skills in interpretation of various spectrums and enhances the employability in all kinds of industries and research institutes where chemical analysis is important. It provides training for employability as scientist/chemist/teacher.

Course Outcomes:

CO1: Compare the classical mechanical and quantum mechanical concepts. (**Understand**)

CO2: Apply the quantum mechanical principles to one electron systems. (**Apply**)

CO3: Explain the principles and applications of Rotational, Vibrational, Electronic and Raman spectroscopy. (**Apply**)

CO4: Explain the principles and applications of NMR and ESR spectroscopy. (**Apply**)

Syllabus Content

Module I: Quantum Mechanics – I (6 Hrs)

Need of quantum mechanics, concept of matter waves, de Broglie relation, uncertainty principle and its significance

Quantum Mechanics: Postulates of quantum mechanics: Schrodinger wave equation – significance of Ψ, well behaved wave functions, Concept of operators- Operator algebra – Linear and Hermitian operators - Laplacian and Hamiltonian operators – Eigen functions and Eigen values of an operator.

Module II: Quantum Mechanics – II (8 Hrs)

Application of quantum mechanics to simple systems – Particle in 1-D box, normalization of wave function, application to linear conjugated polyene (butadiene). Introductory treatment of Schrödinger equation for hydrogen atom.– The wave equation in spherical polar coordinates (derivation not required) - Separation of wave equation - Radial and angular functions (derivation not required) – Orbitals. Quantum numbers and their importance, hydrogen like wave functions – radial and angular wave functions, radial distribution curves.

Molecular orbital theory: basic ideas – criteria for forming MO from AOs, construction of molecular orbital by LCAO method for H_2^+ion (elementary idea only), physical picture of bonding and anti bonding wave functions, concept of σ, σ*, π, π* orbitals and their characteristics.

Module III: Molecular Spectroscopy-I (12 Hrs)

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

Rotation spectroscopy: Introduction to rotational spectroscopy, Rotational energylevels, Selection rules.

Vibrational spectroscopy: Introduction, Selection Rules, Classical equation ofvibration, calculation of force constant, concept of anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands. Degrees of freedom for polyatomic molecules, modes of vibration (H_2O and CO_2 as examples), finger print region, Fermi resonance.

Raman spectroscopy: Introduction, Classical and quantum treatment of Raman effect,Qualitative treatment of Rotational Raman effect; Vibrational Raman spectra, Stokes and anti-Stokes lines: their intensity difference, rule of mutual exclusion.

Module IV: Molecular Spectroscopy-II (10 Hrs)

Electronic spectroscopy: Introduction, selection rule, Franck-Condon principle,electronic transitions, singlet and triplet states, dissociation and predissociation. Polyatomic molecules – qualitative description of σ, π and n- molecular orbitals, their energy levels and the respective transitions. Lambert-Beer's law.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy,Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling.

Electron Spin Resonance (ESR) spectroscopy: Principle, hyperfine structure, ESR ofsimple radical - methyl radical.

TEXTBOOK

1. Gokulachandran, T. M., Thomas, J. K, Physical Chemistry II, Manjusha Publications, First Edition, May 2019

REFERENCES

1. R.K. Prasad, *Quantum Chemistry*, New Age International, 2001
2. Mc Quarrie, J. D. Simon, Physical Chemistry – A molecular Approach, Viva Books.
3. I. N. Levine, *Physical Chemistry*, Tata McGraw Hill,
4. Banwell, C. N. &Mc Cash, E. M. *Fundamentals of Molecular Spectroscopy*,4th Ed. Tata McGraw-Hill: New Delhi (2006).
5. Manas Chanda, Atomic structure and Chemical bonding in Molecular Spectroscopy"Tata McGraw Hill.
6. D. L. Pavia, G. M. Lampman, G. S. Kriz, *Introduction to spectroscopy*, 3rd edn, ThomsonBrooks/Cole, 2001.
7. D. N. Satyanarayana, Electronic absorption spectroscopy and related techniques, Universities Press.
8. D.N. Sathyanarayana, Introduction To Magnetic Resonance Spectroscopy ESR, NMR, NQR, IK International, 2009.
9. Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).
10. GurdeepRaj, *Photochemistry*, 6thEdn, Goel Publishing House, 2014
11. Rohatgi-Mukherjee, *Fundamentals of Photochemistry*, New Age International (P) Ltd.
12. Puri, Sharma &Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co.
13. N. J. Turro, *Modern Molecular Photochemistry*, 4th Edition University Science Books,Sausalito, 1991.
14. Gurdeep Raj, *"Advanced Physical Chemistry"*, Goel Publishing House

SEMESTER VI

CORE COURSE

CH6C09B23: INORGANIC CHEMISTRY

Credits - 3

Hours per week-3 **Total Lecture Hours: 54**

Course Overview and Context

Coordination chemistry, organometallic compounds, interhalogen compounds, noble gas compounds and the role of minor and major trace elements are discussed in detail.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes

CO1: Explain structure, nomenclature, theories, isomerism, spectral, magnetic properties and applications of coordination compounds. (**Apply**)

CO2: Discuss the nomenclature, classification, structure, bonding and catalytic activity of organometallic compounds. (**Understand**)

CO3: Describe the structure and functions of biologically important compounds and toxicity of essential and trace elements. (**Understand**)

CO4: Explain the structure, preparation and properties of interhalogen, boron and noble gas compounds. (**Understand**)

Syllabus Content

Module I: Coordination Chemistry(27 Hrs)

Introduction of coordination compounds, Types of ligands – Anionic, cationic and neutral – IUPAC Nomenclature, Isomerism in coordination compounds –Structural isomerism and stereo isomerism. Chelates, chelate effect-Stability of complexes: Inert and labile complexes

Factors influencing stability. Review of Werner's theory and Sidgwick's concept of coordination – EAN rule.

Bonding theories: Valence bond theory - Geometries of coordination numbers 4 and 6 – Inner orbital and outer orbital complexes- Limitations of VBT. Crystal filed theory - Splitting of *d*-orbitals in octahedral, tetrahedral, tetragonal and square planar complexes - Jahn Teller Effect– Jahn –Teller distortion in Cu(II) complexes. Factors affecting crystal field splitting - CFSE of low spin and high spin octahedral complexes. Spectrochemical series - Explanation of geometry, magnetism and spectral properties - 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. Reactivity of complexes– Ligand substitution reactions- SN_1 and SN_2 substitution reactions of square planar complexes- Trans effect and its applications. Application of coordination chemistry in qualitative and quantitative analysis of metal ions such as Cu^{2+}, Zn^{2+}, Ni^{2+} and Mg^{2+}.

Module II: Organometallic Compounds(12 Hrs)

Definition – Classification based on the nature of metal-carbon bond and on the basis of

hapticity. Naming of organometallic compounds. The 18- electron rule and stability – Ferrocene: Preparation, properties and bonding (VBT only). Metal-alkene complexes- –

Zeise's salt. Catalytic properties of organometallic compounds - Zeigler Natta catalyst in the polymerization of alkene and Wilkinson catalyst in the hydrogenation of alkene (mechanism not expected). Preparation and properties of mononuclear carbonyls - Structures of $Mo(CO)_6$, $Fe(CO)_5$ and $Ni(CO)_4$. Polynuclear carbonyls, bridged carbonyls and bonding in carbonyls –

$Mn_2(CO)_{10}$ and $Fe_{2(}CO)_9$. EAN of metals in metal carbonys – indication of metal-metal

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

Module III : Bioinorganic Chemistry(6 Hrs)

Essential and trace elements in biological systems – Structure and functions of haemoglobin and myoglobin, Vitamin B12 (structure not expected). Electron carriers – cytochromes. Chlorophyll and photosynthesis (mechanism not expected).

Role of alkali and alkaline earth metals in biological systems, Na/K pump. Importance of Ca and Mg. Biological functions and toxicity of metals – Fe, Cu, Zn, Cr, Mn, Ni, Co, Cd, Hg and Pb. Metalloenzymes of zinc and copper, nitrogenase. Treatment of metal toxicity by chelation therapy. Anti cancer drugs – cis platin and carboplatin– Structure and significance.

Module IV: Boron, Inter-halogen and Noble Gas Compounds(9 Hrs)

Boron: Preparation, properties and structure of diborane, borazine, boric acid, boron nitride.

Interhalogens: Classification- general preparation- structures of AB,AB_3, AB_5 and AB_7 types.

Reactivity (ClF, ICl_3, ClF_3, $IF_5$and IF_7). Comparison of pseudohalogens with halogens.Electropositive character of iodine.

Noble Gas: Separation of noble gases (charcoal adsorption method). Compounds of noble gases.

TEXTBOOK

1. Puri, B. R., Sharma, LL. R., Kalia, K. C., Kaushal, G., Inorganic Chemistry, Vishal Publishing Co., Second Edition January 2021

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–PrinciplesofStructure 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*, 31st Edition, Milestone Publishers and Distributors, New Delhi, 2013.
5. P.L. Soni and Mohan Katyal, *Textbook of Inorganic Chemistry*, 20th Edition, S. Chand and Sons, New Delhi, 2013.
6. Satya Prakash, *Advanced Inorganic Chemistry, Volume 2*, S. Chand and Sons, New Delhi, 2005.
7. J.D. Lee, *Concise Inorganic Chemistry*, 5th Edition, Oxford University Press, New Delhi 2008.

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

SEMESTER VI

CORE COURSE

CH6C10B23: ORGANIC CHEMISTRY - IV

Credits - 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Context

Carbohydrates, Amino acids, Proteins, Nucleic Acids and Enzymes, Terpenes, Alkaloids, Vitamins and Lipids, Heterocyclic compounds, Steroids and Hormones are discussed in detail.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes

CO1: Illustrate the preparation, properties and reactions of Natural products like Terpenes,Alkaloids, Lipids, Vitamins, Steroids and Hormones. (**Apply**)

CO2: Explain the preparation, properties and applications of Carbohydrates, Amino acids, Peptides and Enzymes. (**Apply**)

CO3: Explain the structure, properties and functions of Nucleic acids. (**Understand**)

CO4: Generalize the principles and applications of Supramolecular Chemistry and Organic Photochemistry. (**Understand**)

Syllabus Content

Module I : Natural Products – I (18 Hrs)

*Terpenoids:*Classification. Isoprene rule. Structure elucidation and uses of citral and geraniol. Natural rubber - structure, latex processing methods, vulcanisation, rubber compounding, mastication and uses.

Alkaloids: General methods of isolation. Classification. Physiological action and medicinal importance. Structure elucidation and synthesis of coniine, nicotine and piperine.

*Lipids:*Introduction to lipids. Classification: Oils and fats: Biological functions. Extraction and refining. Common fatty acids present in oils and fats. Omega fatty acids. Trans fats and their effect. Hydrogenation, Rancidity. Acid value, Saponification value, Iodine value and RM value. Biological functions of waxes, phospholipids and glycolipids.Soaps - Types of soaps. Cleansing action of soaps.Synthetic detergents - Classification. Detergent additives. Comparison between soaps and detergents. Environmental aspects. ABS and LAS detergents.

Vitamins: Classification. Structure, biological functions and deficiency diseases of vitamins A, B_1, B_2, B_3, B_5, B_6, C and D.

*Steroids:*Introduction.Diels'hydrocarbon.Structure and functions ofcholesterol.Elementary idea of HDL and LDL.

Hormones: Introduction. Examples and biological functions of steroid hormones, peptidehormones and amine hormones (structure not required). Artificial hormones.

Module II : Natural Products - II (23 Hrs)

Carbohydrates: Classification of carbohydrates. Reducing and non-reducing sugars. General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and

anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections.

Cyclic structure of fructose. Chain lengthening and chain shortening of aldoses - Kiliani-Fischer synthesis and Wohl degradation. Interconversion of aldoses and ketoses.Linkage between monosaccharides. Structure of the disaccharides sucrose, maltose and cellobiose (excluding their structure elucidation). Reactions and uses of sucrose. Artificial sugars (sweeteners) – sucralose. Structure of the polysaccharides starch and cellulose (excluding their structure elucidation). Industrial applications of cellulose.

Amino Acids, Peptides and Proteins: Classification of amino acids. Synthesis, ionic properties and reactions of α-amino acids. Zwitterion structure and Isoelectric point, Polypeptides. Synthesis of simple peptides (uptotripeptides) by N-protecting (benzyloxy carbonyl and *t*-butyloxy carbonyl) & C-activating groups. DCC method. Merrifield's solid phase peptide synthesis. Classification of proteins. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of proteins. Determination of N-terminal amino acid (by FDNB and Edman method) and C–terminal amino acid (by hydrazinolysis and with carboxypeptidase enzyme). Helical and sheet structures. Denaturation of proteins.

Enzymes: Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (Including stereospecificity). Enzyme inhibitors and their importance. Uses of enzymes.

Module III : Nucleic Acids (6 Hrs)

Components of Nucleic acids: Adenine, guanine, cytosine, thymine and uracil (structure only), other components of nucleic acids. Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson - Crick Model) and RNA. Biological functions of DNA and RNA - Replication and protein biosynthesis. Transcription and Translation. Genetic code.

Module IV : Supramolecular Chemistry and Organic Photochemistry (7 Hrs)

*Supramolecular Chemistry:*Introduction. Molecular recognition. Host-guest interactions. Types of non-covalent interactions and molecular receptors. Role of molecular recognition in biopolymer (DNA and protein) structure organisation (elementary idea only).

Organic Photochemistry: Introduction. Photochemical versus Thermal reactions. Electronic excitation and fate of excited molecules. Jablonski diagram. Fluorescence and phosphorescence. Photosensitisation. Photochemical reactions: Norrish type I and IIreactions of acyclic ketones, Paterno-Buchi reaction and Photo-Fries reaction (with mechanisms).

TEXTBOOKS

1. Sharma, Y. R, Chemistry of Natural Product and Biomolecules, Kalyani Publishers, 2011
2. Gem Mathew, G. D., Ramachandran P. R., Organic Chemistry-IV, Vishal Publishing Co., Vishal Publishing Co., January 2021

REFERENCES

1. Finar, I. L. *Organic Chemistry* (*Volume 2),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry*, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
3. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry*, 7th ed., W. H. Freeman.

4. Berg, J.M., Tymoczko, J.L. &Stryer, L. *Biochemistry*, W.H. Freeman, 2002.
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.
8. Tewari, K.S. &Vishnoi, N.K. *Organic Chemistry*, Vikas Publishing House, 2012.
9. Billmeyer, F.W. *Textbook of Polymer Science,* Wiley.
10. Gowariker, V.R., Viswanathan, N.V. & Sreedhar J. *Polymer Science*, 2nd ed., New Age, 2015
11. Steed, J. W. & Atwood, J.L. *Supramolecular Chemistry*, 2nd ed., Wiley, 2009.
12. Dodziuk, H. *Introduction to Supramolecular Chemistry*, Springer, 2002.

SEMESTER VI

CORE COURSE

CH6C11B23: PHYSICAL CHEMISTRY – III

Credits – 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Context

To study about First law, second law, third law of thermodynamics, chemical equilibrium, Phase equilibria and chemical kinetics.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes

CO1: Illustrate the basic concepts, laws and significance of thermodynamics, thermochemistry and chemical equilibria in solving problems (**Apply**)

CO2: Explain ionic equilibria using the concepts of acids and bases and hydrolysis of salts. (**Apply**)

CO3: Explain the phase rule and phase diagrams of one component and two component systems. (**Understand**)

CO4: Explain the kinetics of first order, second order, zero order, complex reactions and catalysis, collision theory, transition state theory, Lindemann theory and the effect of temperature on the rate of reaction (**Apply**)

Syllabus Content

Module I: Thermodynamics (27 Hrs)

Basic concepts- system, surroundings, types of systems. Extensive and intensive properties, macroscopic properties. State functions and path functions. Types of Processes, Zeroth law of thermodynamics. Definition of internal energy and enthalpy. Heat capacities at constant volume (C_v) and at constant pressure (C_p), relationship between C_p and C_v.

First law of thermodynamics –Mathematical statement of first law. Reversible process and maximum work. Calculation of work, heat, internal energy change and enthalpy change for the expansion of an ideal gas under reversible isothermal and adiabatic condition.

The Joule-Thomson effect – derivation of the expression for Joule-Thomson coefficient. Sign and magnitude of Joule-Thomson coefficient, inversion temperature. Liquefaction of gases.

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

Second law: Limitations of first law – Different statements of II^{nd} law, Thermodynamic scale of temperature. Carnot cycle and its efficiency, Carnot theorem.

Concept of entropy – Definition and physical significance. Entropy as a function of volume and temperature, Entropy as a function of pressure and temperature. Entropy as a criteria of spontaneity and equilibrium.

Gibbs and Helmholtz free energies and their significances- criteria of equilibrium and spontaneity. Gibbs-Helmholtz equation, dependence of Gibbs free energy change on

temperature, volume and pressure.

Third law of thermodynamics-statement and determination of absolute entropies of substances.

Module II :Equilibria – Chemical and Ionic (11 Hrs)

*Chemical Equilibria:*Law of mass action-equilibrium constant – Relation between Kp, Kc and Kx – Thermodynamic treatment of the law of mass action – Vant Hoff reaction isotherm

– Temperature dependence of the equilibrium constant – The Van't Hoffs equation –Pressure dependence of the equilibrium constant Kp.

Ionic Equilibria: Introduction – Concepts of acids and bases, relative strength of acid-base pairs, influence ofsolvents, Dissociation constants – acids, bases, and polyprotic acids. Ostwald's dilution law. Degree of ionization, factors affecting degree of ionization, ionization

constant and ionic product of water-pH. Effects of solvents on ionic strength. Buffer solutions – Mechanism of buffer action, Henderson equation. Hydrolysis of salts – degree of hydrolysis and hydrolysis constant, determination of degree of hydrolysis, pH of salt solutions.

Module III : Phase equilibria (6 Hrs)

The phase rule-derivation, equilibrium between phases – conditions. One component system – watersystem, 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.

Module IV: Chemical Kinetics (10 Hrs)

Rate of reaction, rate equation, order and molecularity of reactions, determination of order of a reaction.Integratedrateexpressions for first and second order reactions ($2A \rightarrow P$ and $A + B \rightarrow P$). Zero order reactions, pseudoorderreactions, 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. Theory of unimolecular reactions – Lindemann Theory.

Kinetics of complex (composite) reactions: Opposing reactions, consecutive reactions, and parallel (simultaneous) reactions. Chain reactions – steady state treatment, Hydrogen–Bromine reaction- derivation of rate expression.

Catalysis: Homogeneous catalysis, enzyme catalysis – Michaelis–Menten equation (no derivation needed). Heterogeneous catalysis – Surface catalysis, Elementary idea about Autocatalysis.

TEXTBOOK

1. Gokulachandran, T. M., Thomas, J. K, Physical Chemistry III, Manjusha Publications, First Edition, November 2019

REFERENCES

1. R. P. Rastogi, R. R. Misra, *An Introduction to Chemical Thermodynamics,* 6thedn., Vikas Pub. Pvt. Ltd. (2003).
2. P. Atkins and J Paula, *The elements of Physical chemistry*, 7thedn., Oxford University Press.

3. K.K. Sharma, L.K. Sharma, *A Textbook of Physical Chemistry*, 4th edn, Vikas publishing House.
4. B. R. Puri, L. R. Sharma, M. S. Pathania, *Elements of Physical chemistry*, Vishal Pub. Co. Jalandhar
5. J. Rajaram and J. C. Kuriakose, *Thermodynamics*, ShobanLalNagin Chand & Co (1986).
6. D. A. McQuarrie, J. D. Simon, *Physical Chemistry – A molecular* Approach, Viva Books Pvt. Ltd.
7. F. A. Alberty and R. J .Silby, *Physical Chemistry*, John Wiley.
8. F Daniels and R AAlberty, *Physical Chemistry*, Wiley Eastern.
9. Gurdeep Raj, *Advanced Physical Chemistry*, Goel Publishing House.
10. S. Glasstone, *Thermodynamics for Chemists*, Affiliated East West Publishers.
11. G.S. Rush Brooke, *Statistical Mechanics*, Oxford University Press.
12. K. L. Kapoor, A *Textbook of Physical chemistry, Volumes 3*, Macmillan India Ltd.
13. Gurdeep Raj, *Chemical Kinetics*, Krishna's Educational Publishers (2014).
14. K. J. Laidler, *Chemical kinetics*, 3rd edn, Pearson education, 2004.

SEMESTER VI

CORE COURSE

CH6C12B23: PHYSICAL CHEMISTRY – IV

Credits – 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Context

Detailed study of solution chemistry, Electrical Conductance, Electromotive force, Photochemistry and group theory at graduate level**.** Applications of electrical conductance and EMF is discussed in detail.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes

CO1: Explain theories and laws of binary liquid solutions, gases in liquids, electrical conductance measurements and colligative property. (**Apply**)

CO2: Explain the Galvanic cell, concentration cells, fuel cell, thermodynamics of cell, applications of EMF and electrical conductance measurements. (**Apply**)

CO3: Discuss the laws of photochemistry, Jablonski diagram, Quantum yield and selected photochemical reactions (**Understand**)

CO4: Explain the symmetry elements of group theory and determination of point groups of simple molecules. (**Understand**)

Syllabus Content

Module I : Solution Chemistry (24 Hrs)

Introduction – Binary liquid solutions – Raoult's law- ideal and non-ideal solutions– G_{mix}, V_{mix}, and $S_{mix}$for ideal solutions. Vapour pressure – composition and temperature–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).

Solubility of gases in liquids – Henry's law. Distribution of a solute between two solvents–Nernst distribution law.

Partial molar quantities – Chemical potential – Gibbs–Duhem equation. 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't Hoff factor – Degree of association and Degree of dissociation.

Electrical Conductance: Introduction- Faraday's laws of electrolysis, electrochemical equivalent& chemical equivalent. Electrolytic conductivity, molar conductivity – Variation of molar conductivity with concentration. Kohlrausch's law – Applications.Abnormal ion conductivity of hydrogen and hydroxyl ions.Transference number and its experimental determination using Hittorf and Moving boundary methods.

Debye-Hückel theory of strong electrolytes – the concept of ionic atmosphere, Asymmetry and electrophoretic effect, Debye- Hückel-Onsager equation (no derivation). 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, determination of solubility and solubility products of sparingly soluble salts, conductometric titrations involving strong acid- strong base, weak acid- strong base, mixture of a strong acid and weak acid against strong base and precipitation titrations.

Module II : Electromotive Force (15 Hrs)

Introduction – Electrochemical cells and electrolytic cells, Galvanic cells, characteristics of reversible cells. Reversible electrodes – Different types, Reference electrodes – Standard Hydrogen Electrode, Calomel electrode, Electrode potential – Electrochemical series. Representation of cells, Electrode reactions and cell reactions.

Derivation of Nernst equation for electrode potential and cell potential, Gibb's Helmholtz equation and EMF of a cell, calculation of G, H and S from EMF data. Calculation of equilibrium constant from EMF data.

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

Applications of emf measurements – determination of solubility product, determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode.

Potentiometric titrations of acid-base and redox reaction, oxidation reduction indicators. Irreversible electrode processes – overvoltage.

Corrosion of metals – forms of corrosion,corrosion monitoring and prevention methods.

Module III : Photochemistry (6 Hrs)

Laws of photochemistry-Grothus-Draper law, Stark-Einstein law. Jablonsky diagram-qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Quenching of fluorescence.

Quantum yield, examples of low and high quantum yields, photochemical reactions (decomposition of HBr, isomerisation of maleic acid to fumaric acid), photosensitised reactions (photosynthesis, isomerization of 2-butene), chemiluminescence, bioluminescence.

Module IV : Group Theory (9 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.

TEXTBOOK

1. Gokulachandran, T. M., Thomas, J. K, Physical Chemistry IV, Manjusha Publications, First Edition, November 2019

REFERENCES

1. B. R. Puri, L. R. Sharma, M. S. Pathania, *Elements of Physical chemistry*, VishalPub. Co. Jalandhar.
2. K. L. Kapoor, *A Textbook of Physical chemistry*, *Volume 4*, Macmillan India Ltd.
3. Barrow, G.M. *Physical Chemistry*,Tata McGraw-Hill (2007).
4. Castellan, G.W. *Physical Chemistry*,4th Ed. Narosa (2004).
5. Kotz, J.C., Treichel, P.M. & Townsend, J.R., *General Chemistry*, Cengage Learning India Pvt. Ltd. New Delhi (2009).
6. Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).

7. K. L. Kapoor, *A Textbook of Physical chemistry*, *Volumes 1*, Macmillan India Ltd,
8. Glasstone S, *An Introduction to Electrochemistry*, East-West Press (Pvt.) Ltd. (2006).
9. Gurdeep Raj, *Advanced Physical Chemistry*, Goel publishing house.
10. Glasstone and Lewis, *Elements of Physical Chemistry*, Macmillan
11. K. L. Kapoor, *A Textbook of Physical chemistry*, *Volumes 3*, Macmillan IndiaLtd.
12. I.N. Levine, *Physical Chemistry*, Tata McGraw Hill
13. F AAlberty and R J Silby, *Physical Chemistry*, John Wiley.
14. P. W. Atkins,*The elements of Physical chemistry*, 8thedn, Oxford UniversityPress.
15. D. A. McQuarrie, J. D. Simon, *Physical Chemistry – A molecular Approach*, Viva Books Pvt.Ltd.
16. S. H. Marron and J. B. Lando, *Fundamentals of Physical Chemistry*, MacmillanLtd.
17. G. K. Vemulapalli, *Physical Chemistry*, Prentice-Hall of India Pvt. Ltd. (1997) V Ramakrishnan and M S Gopinathan, *"Group Theory in Chemistry"*, Vishal Publishing.

SEMESTER V AND VI

CORE COURSE

CH6CP03B23: QUALITATIVE INORGANIC MICRO ANALYSIS

Credits – 2

Hours per week: 3 **Total Hours: 108**

Course overview and Context

The course provides training in qualitative micro analysis of inorganic anions and cations from a mixture of simple inorganic mixture of two salts.

The course provides skill development in analysing the presence of inorganic species useful for employability as analytical chemist.

Course Outcomes

CO1: Determine the anions and cations in a given inorganic salt mixture by semi-micro method (**Apply**)

CO2: Develop analytical skills in the qualitative analysis of inorganic substances by semi-micro method(**Apply**)

CO3: Record systematically the experimental procedures, observations and conclusions. (**Apply**)

Syllabus content

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+}, Al^{3+}, Cr^{3+}, Zn^{2+} , Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, Li^{+} , Na^{+} , K^{+} , $NH4^{+}$. CO_3^{2-}, S^{2-} , SO_4^{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 and with one interfering radical by Semi-micro method only. (Minimum of 10 mixtures to be analysed)

TEXTBOOK

1. Murikallel, J., Rajan J. L., Willington, J., Methikkalam, R. R. J., Chemical Analysis, Vol. II, Second Edition 2014

REFERENCES

1. 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-microInorganic Analysis, revised, Orient Longman.
3. V. V. Ramanujam, 'Inorganic Semi-microQualitative Analysis', The National Publishing Co., Chennai,
4. W. G. Palmer 'Experimental Inorganic Chemistry', Cambridge.

SEMESTER V AND VI

CORE COURSE

CH6CP04B23: ORGANIC PREPARATIONS AND LABORATORY TECHNIQUES

Credits-2

Hours per week: 2 **Total Hours: 72**

Course overview and Context

The course provides training in quantitative organic analysis, preparation and purification techniques.

The course provides skill development in analysing various classes of organic compounds, which will be useful in the synthetic organic chemistry and pharmaceutical chemistry, nutritional chemistry.

Course Outcomes

CO1: Develop analytical skills in quantitative analysis by preparation, distillation, separation and purification of organic compounds (**Apply**)

CO2: Prepare organic compounds using different types of reactions, record the yield and recrystallize them. (**Apply**)

CO3: Illustrate separation of two organic compounds using Thin Layer chromatography and by computing the Rf value. (**Apply**)

CO4: Explain the techniques of solvent extraction and column chromatography. (**Understand**)

Syllabus content

A. Basic Laboratory Techniques

1. Crystallisation – Any four compounds using ethyl acetate, ethanol, and water - Record the yield of recovery.
2. Distillation - Purification of water and ethyl acetate-Record the yield of recovery.
3. Solvent extraction – aniline from water - methyl benzoate from water - using ether-(Only demonstration)
4. Record the yield of recovery. (*Any two experiments shall be done*).

B. Organic Preparations

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. Acylation (Benzoylation of aniline, phenol, β-naphthol).
6. Esterification (benzoic acid ester).
7. Iodoform from acetone or ethyl methyl ketone.
8. Side chain oxidation (benzyl chloride to benzoic acid).
9. Claisen – Schmidt reaction: Dibenzal acetone from benzaldyde.

C. Chromatography

1. TLC - Separation and identification- Determination of Rf value of *o*-and *p*-nitroanilines,
2. *o*- and *p*-chloroanilines, *p*-chlorophenol and *p*-nitrophenol, *p*-chloroaniline and *p*–nitroaniline, benzil and *o*-nitroaniline or any two amino acids.
3. Column Chromatography – Purification of *o*-nitro aniline, o-nitrophenol, benzil, m-dinitro benzene, benzene azo –β-naphthol (*non–evaluative*).

TEXTBOOK

1. Murikallel, J., Rajan J. L., Willington, J., Methikkalam, R. R. J., Chemical Analysis, Vol. II, Second Edition 2014

REFERENCES

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V. Smith, P.W.G.; Tatchell, A.R. *Vogel'sTextbook of Practical Organic Chemistry,* 5th ed., Pearson Education, 2005.
2. Mann,F.G.; Saunders, B.C. *Practical Organic Chemistry*, 4th ed., Pearson Education, 2009.
3. Ahluwalia, V.K.; Aggarwal, R. *Comprehensive Practical Organic Chemistry – Preparation and Quantitative Analysis,* Universities Press, 2000.

SEMESTER V AND VI

CORE COURSE

CH6CP05B23: PHYSICAL CHEMISTRY PRACTICALS

Credits – 2

Hours per week: 3 **Total Lecture Hours: 108**

Course overview and Context:

The course provides training in determination of physical parameters.

The course provides skill development studies related to various physical properties of chemicals/Training for employability as material scientist, environmental analyst.

Course Outcomes

CO1: Determine the physical parameters of liquids using experiments based on Viscosity, Surface tension, Critical Solution Temperature, Transition Temperature and Thermochemistry. (**Apply**)

CO2: Develop skills in the scientific method of planning, conducting, and accurately reporting experiments based on Conductometry, Potentiometry, Rast method and Chemical kinetics. (**Apply**)

CO3: Illustrate graphically the equivalence point and unknown concentration of solutions manually/ using spreadsheet programme. (**Apply**)

Syllabus Content

1. Viscosity – percentage composition of a mixture.
2. Heat of solution – KNO3, NH4Cl
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. Transition temperature of salt hydrates. (Sodium thiosulphate, sodium acetate)
7. Determination of the surface tension of a liquid(Drop number method or Drop weight method)
8. Critical solution temperature of phenol-water system.
9. Effect of electrolytes on the CST of phenol-water system.
10. Molecular weight determination by Rast's method. (usingnaphthalene,camphor or biphenyl as solvent and acetanilide, p-dichlorobenzene etc. as solute.)
11. Kinetics of simple reactions eg. Acid hydrolysis of methyl acetate.
12. Potentiometric titration – Fe2+vs. Cr2O72–, I-vs. MnO4–
13. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant)
14. Determination of equivalence point of potentiometric and conductometric titrations using spreadsheet program.

TEXTBOOK

1. Murikallel, J., Rajan J. L., Willington, J., Methikkalam, R. R. J., Chemical Analysis, Vol. II, Second Edition 2014.

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. Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry,*R. Chand & Co.: New Delhi (2011).

SEMESTER VI

CORE COURSE

CH6CP06B23: GRAVIMETRIC ANALYSIS

Credits – 2

Hours per week: 2 **Total Lecture Hours: 36**

Course overview and Context

The course provides training in quantitative determination of metal ions by gravimetric analysis.

The course provides skill development in precipitation techniques/training for employability as analytical chemistry

Course Outcomes

CO1: Explain the principle, standard procedure and calculation of Ba^{2+}, Fe^{2+} , Cu^{2+}, Ni^{2+} (**Understand**)

CO2: Develop skills in quantitative analysis based on gravimetry (**Apply**).

Syllabus Content

1. Estimation of Barium as barium sulphate
2. Estimation of iron as Fe_2O_3
3. Estimation of sulphate as barium sulphate
4. Estimation of copper as cuprous thiocynate
5. Estimation of nickel as nickel dimethyl glyoxime.

TEXTBOOK

1. Murikallel, J., Rajan J. L., Willington, J., Methikkalam, R. R. J., Chemical Analysis, Vol. II, Second Edition 2014

REFERENCES

1. J. Mendham. R.C. Denney, J.D. Barnes and M. Thomas, *Vogel's Textbook ofQuantitative Chemical Analysis*, 6th Edition, Pearson Education, Noida, 2013.
2. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, *Fundamentals of AnalyticalChemistry*, 8th Edition, Brooks/Cole, Thomson Learning, Inc., USA, 2004.
3. G. D. Christian, Analytical Chemistry, JohnWiley and Sons.
4. R. D. Day, A. L. Uderwood, Quantitative analysis.

SEMESTER V AND VI

CORE COURSE

CH6PRB23: PROJECT

Credits – 2

Total Lecture Hours: 36

Course overview and Context

The course provides training in identification of relevant research problems, experimental design, analysis and interpretation of data and presentation of the research project.

The course provides research skill development, focusing employability and multiple careeroriented skills.

The course provides opportunity to identify projects which are relevant from environmental and social aspects.

Course Outcomes

CO1: Identify relevant problems related to environmental, industrial and social concerns (**Apply**)

CO2: Design experiments, synthesize, analyze, and interpret data to provide solutions for the identified problems (**Apply**)

CO3: Develop critical thinking, problem-solving and presentation skills in the areas of chemistry while observing responsible and ethical scientific conduct (**Apply**)

SYLLABI FOR CHOICE BASED CORE COURSES

SYLLABI FOR CHOICE BASED CORE COURSES

SEMESTER VI

CHOICE BASED CORE COURSES

CH6C13AB23: NANOCHEMISTRY AND NANOTECHNOLOGY

Credits – 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Context

To study about nanomaterials, their characterization techniques like SEM, TEM, SPL, SIMS etc. It also discusses the electrical and optical properties of nanomaterials. The application of these materials in biology, medicine and as catalysts is discussed in detail.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes

CO1: Illustrate the history, classification, synthesis, preparation and applications of nanomaterials with special reference to Carbon nanotubes, Fullerenes, Self-assembled monolayers and Quantum dots. (**Understand**)

CO2: Explain various Nano structural characterization techniques like SEM,TEM, STEM, ETEM, SPL, SIMS and AFM. (**Understand**)

CO3: Describe the electrical and optical properties of nanomaterials. (**Understand**)

CO4: Apply the knowledge of nanomaterials in the field of medicine, drug delivery, biotechnology, catalyst, sensors and their potential effects. (**Apply**)

Syllabus Content:

Module I : Introduction to Nanomaterials (18 Hrs)

History-Feynman's hypothesis- scales of nanosystems- Moore's law-Classification of nanomaterials based on dimensions -quantum dots-. Different types of nanomaterials. Synthesis, properties and applications of fullerenes, carbon nanotubes and quantum dots. Various approaches in nanoparticle synthesis: CVD, Laser ablation and Arc discharge - self-assembled monolayers, monolayer protected metal nanoparticles.

Module II : Characterization of Nanomaterials (18 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) and atomic force microscopy (AFM).

Module III : Electrical and Optical Properties of Nanomaterials (6 Hrs)

Electrical and optical properties of metal nanoparticles- electrical and optical properties of carbon nanotubes.

Module IV : Applications of Nanomaterials (12 Hrs)

Nanocatalysis – nanomedicines - immunogold labeling- applications in medical diagnosis-nanobased drug delivery. Applications in biotechnology -nanosensors- self-assebly, nanosensor based on quantum size effects- nanobiosensors- destructive applications of nanomaterials.

TEXTBOOK

1. T. Pradeep, Nano: The Essentials, McGraw Hill Publishing Company, New Delhi (2007).

REFERENCES

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

SEMESTER VI

CHOICE BASED CORE COURSES

CH6C13BB23: POLYMER CHEMISTRY

Credits – 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Context

To study about the preparation, properties, structure and application of polymers.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes

CO1: Classify polymers, polymerisation processes and polymerisation techniques. (**Understand**)

CO2: Discuss the structure-property relationship of polymers. (**Understand**)

CO3: Explain the reaction of polymers, polymer degradation, and polymer processing techniques. (**Understand**)

CO4: Discuss preparation, structure, property and application of selected commercial polymers and specialty polymers.(**Understand**)

Syllabus Content

Module I: Introduction and History of Polymeric Materials (4 Hrs)

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

Module II : 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. Mechanism of copolymerization. Mechanism of ring opening and group transfer polymerisations.

Module III :Polymerisation Techniques (4 Hrs)

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

Module IV: Physical Properties of Polymers (14 Hrs)

Structure-Property relationships of polymers.

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

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

Glass Transition Temperature (T_g): Definition. Factors influencing glass transitiontemperature (T_g). T_g and molecular weight. T_g and melting point. Importance of T_g.

Module V: Reactions of Polymers (4 Hrs)

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

Module VI: Polymer Degradation (4 Hrs)

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

Module VII : Polymer Processing (4 Hrs)

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

Module VIII: 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(vinyl acetate), 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.

Module IX : Specialty Polymers (6 Hrs)

High temperature resistant and flame-retardant polymers. Biomedical applications of polymers. Controlled drug delivery systems. Conducting polymers - polyacetylene, polyaniline, poly(p-phenylenesulphide), polypyrrole, polythiophene. Conduction mechanism and applications. Carbon nanotubes. Synthesis and applications (elementary idea only).

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.

SEMESTER VI

CHOICE BASED CORE COURSES

CH6C13CB23: SOIL AND AGRICULTURAL CHEMISTRY

Credits – 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Context

To study about the origin, physical and chemical nature of soils and means to enhance the quality of soil.

The course provides training for employability as scientist/chemist/teacher.

Course Outcomes

CO1: Describe the origin of soil. (**Understand**)

CO2: Explain the physical and chemical aspects of soil chemistry. (**Understand**)

CO3: Discuss the different types, role and requirements of plant nutrients and fertilizers.(**Understand**)

CO4: Discuss the different types of pesticides, fungicides and herbicides. (**Understand**)

Syllabus Content

Module I: 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.

Module II: 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.

Module III: Chemistry Aspects of Soil (9 Hrs)

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.

Module IV: 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.

Module V: 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.

SYLLABI FOR OPEN COURSE

SYLLABI FOR OPEN COURSE

SEMESTER V

OPEN COURSE

CH5D01AB23: CHEMISTRY IN EVERYDAY LIFE

(Chemical structures are non-evaluative)

Credits – 3

Hours per week: 4 **Total Lecture Hours: 72**

Course Overview and Context

This unit deals with food additives, chemicals used in agriculture, soaps, detergents, cosmetics, plastics, cement, paints, paper, dyes, drugs and vitamins used in everyday life.

The course increases the job opportunities of students in chemical industries. It also encourages students to be entrepreneurs.

The course also generates environmental consciousness in students about the negative aspects of chemicals.

Course Outcomes

CO1: Illustrate the different types of food additives, their importance, toxicity and health effects. (**Understand**)

CO2: Discuss the different types of fertilizers, plant growth hormones, pesticides and their impact on the environment. (**Understand**)

CO3: Describe the preparation, classification and environmental aspects of soaps, detergents and cosmetics. (**Understand**)

CO4: Summarize the classification, uses and environmental impact of plastics, papers, dyes, paints and cement with examples. (Understand)

CO5: Explain classification and importance of drugs and vitamins with examples (**Understand**)

Syllabus Content

Module I: Food Additives and Agricultural Chemistry(24 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.

Chemistry and Agriculture: 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.

Module II: Soaps, Detergents and Cosmetics(18 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.

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

Module III: Plastics, Paper, Dyes , Paints and Cement (18 Hrs)

Plastics: Plastics and Polymers. Types and classification of polymers. Source and general characteristics of natural and synthetic polymers. Typical examples of polymers used as commodity plastics, textiles, electronic and automobile components, medical and aerospace materials.International recycling codes, and symbols for identification of plastics. Environmental hazards of plastics. Biodegradable plastics. Recycling of plastics.

Paper: Introduction. Paper manufacture (basic idea only). Weight and size of paper. Types of paper - News print paper, writing paper, paperboards, cardboards. Environmental impact of paper.

Dyes: Natural and synthetic dyes with examples (elementary idea only).

Paints: Paints and distempers, Requirements of a good paint. Emulsion, latex, luminescent paints. Fire retardant paints, varnishes, enamels, lacquers, solvents and thinners.

Cement: Types, additives, setting and properties.

Module IV: Drugs and Vitamins (12 Hrs)

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

Vitamins: Classification and Nomenclature. Source and deficiency diseases, biological functions of Vitamins- Vitamin A, Vitamin B, Vitamin C & Vitamin K.

TEXTBOOK

1. Gem Mathew, G. D., Chemistry in Everyday Life, Vishal Publishing Co., 2019.

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.
17. Singh, K., *Chemistry in Daily Life;* Prentice Hall of India, New Delhi, 2008.
18. Sharma, B.K., *Introduction to Industrial Chemistry*, Goel Publishing, Meerut,1998.

SEMESTER V

OPEN COURSE

CH5D01BB23: NANOSCIENCE AND NANOTECHNOLOGY

Credits – 3

Hours per week: 4 **Total Lecture Hours: 72**

Course Overview and Context:

This coursedealswithsynthesis, properties and applications of nanomaterials, the spectroscopic techniques used for the characterization of nano systems and the use of nanotechnology in medical diagnosis.

The course increases the job opportunities of students as nanotechnology is an important branch of science which is widely utilized in industries and research.

The course also emphasizes on the social, economic and ethical perspectives of nanoscience.

Course Outcomes:

CO1: Summarize the synthesis, properties and applications of nanomaterials with special reference to carbon nanotubes and fullerenes. (**Understand**)

CO2: Review the social, economic and ethical perspectives of nanoscience. (**Understand**)

CO3: Describe the spectroscopic techniques used for the characterization of nano systems. (**Understand**)

CO4: Extend the knowledge of nanotechnology to nanobiology and medical diagnosis. (**Understand**)

Syllabus Content

Module I: History of Nanotechnology (18 Hrs)

Historical landmarks- terminology-scales. Top-down and bottom-up paths in nanoscience. Feynman's hypothesis-Moore's law -Types of nanomaterials: fullerene- its discovery-production-contribution to nanotechnology-unusual properties of fullerene. Nanotubes:carbon nanotubes- synthesis- properties and applications.

Module II: Nanoscience: Its Social, Economic and Ethical Perspectives (18 Hrs)

Existing laws and regulations of nanotechnology- regulatory agencies- intellectual property policy of nanotechnology. Energy challenges-environmental impacts of nanotechnology - green nanotechnology- technology business: nano economics- entrepreneurs in the technological ecosystem- nanoethics - future of nanotechnology.

Module III: Seeing the Nanoworld (18Hrs)

Fundamental particles-electromagnetic radiation- its components- impact on matter-the Planck's equation- de Broglie relation- matter-wave concept of radiation- concept of colour and vision-Auxochromes and chromophores- spectroscopic methods and radiation-elementary ideas of UV-visible, XPES and UPES techniques, SEM, TEM, SPL, and SIMS - their use in the studies of nanosystems (theory is not expected).

Module IV: Applications of Nanotechnology (18 Hrs)

Nanobiology and its applications- Nanomedicines- immuno targeted drug delivery--nanoparticle drug systems for oral, nasal, and ocular administration- nanomaterials in medical diagnosis - therapeutic applications. Nanosensors- smart dusts. 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.

SEMESTER V

OPEN COURSE

CH5D01CB23: FORENSIC SCIENCE

Credits – 3

Hours per week: 4 **Total Lecture Hours: 72**

Course Overview and Context:

This course deals with types of poisons, symptoms and treatments, methods of crime detection, finger printing types of forgery and counterfeiting.

The course increases the job opportunities of students in forensics.

Course Outcomes:

CO1: Identify the type of poisons, their clinical symptoms and treatment. (**Understand**)

CO2: Interpret the evidence involved in crimes associated with explosives. (**Understand**)

CO3: Identify the different types of forgery and counterfeiting. (**Understand**)

CO4: Interpret the biological forensic evidence from the crime scene. (**Understand**)

CO5: Discuss the chemistry involved in metabolite analysis, arson and powder residue. (**Understand**)

Syllabus Content

Module I: 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.

Module II : Crime Detection (12 Hrs)

Accidental explosion during manufacture of matches and fireworks. 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.

Module III: 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.

Module IV: 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 markpaints – 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.

Module V: Medical Aspects (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.

SYLLABI FOR COMPLEMENTARY COURSES FOR BOTANY, ZOOLOGY AND HOME SCIENCE

SYLLABI FOR COMPLEMENTARY COURSES FOR BOTANY, ZOOLOGY AND HOME SCIENCE

SEMESTER I

COMPLEMENTARY COURSE

CH1B01B23: BASIC THEORETICAL AND ANALYTICAL CHEMISTRY

Credits – 2

Hours per week: 2 **Total Lecture Hours: 36**

Course Overview and Context

The course explains atomic structure, acids and bases, theory of indicators, principles of precipitation, analytical techniques, titrimetry, separation and purification techniques. Different chromatographic techniques are also dealt with.

Course Outcomes:

CO1: Describe the Bohr atom model, types of bonds, Valence bond and VSEPR theories andHybridization. (**Understand**)

CO2: Explain the periodic properties of elements and concepts of chemical equilibrium. (**Apply**)

CO3: Identify methods for separating a given organic compound from a reaction mixture and quantification of inorganic metal ions using titrimetric and gravimetric analysis (**Understand**)

CO4: Differentiate between column chromatography, PC, TLC, GC, IEC and HPLC techniques (**Understand**)

Syllabus Content

Module I : Atomic Structure and Chemical Bonding(12 Hrs)

Atomic Structure: Bohr atom model and its limitations, 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.

Chemical Bonding: Introduction – Type of bonds. Ionic bond: Factors favouringtheformation of ionic bonds. Covalent bond: Valence bond theory – Coordinate bond. VSEPR theory and examples. Hybridisation: - sp^3, sp^2 and *sp* (ethane, ethene, ethyne). Intermolecular forces - Hydrogen bonding in H_2O - Dipole-dipole interactions.

Module II : Fundamental Concepts in Chemistry (9 hrs)

Periodic Properties: Modern periodic law – Long form of periodic table. Periodicity inproperties: Atomic radii, ionic radii, ionization enthalpy, electron affinity (electron gain enthalpy) and electronegativity (Pauling scale). Atomic mass - Molecular mass - Mole concept – Molar volume - Oxidation and reduction – Oxidation number and valency -

Equivalent mass.

Concept of Equilibrium: Acids and Bases - Arrhenius, Lowry-Bronsted and Lewis theories.Ionic product of water - pH and pOH, Strengths of acids and bases - K_a and K_b, pK_a and pK_b. Buffer solution. Solubility, solubility product, common ion effect and their applications.

Module III : Basic Principles of Analytical Chemistry (9 Hrs)

Methods of Analysis: Volumetric method of analysis - General principles. Primary andsecondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions, end point. Acid base, redox and complexometric titrations and corresponding indicators. Double burette method of titration: Principle and advantages. Microanalysis and its advantages. Gravimetric method of analysis: General principles.

Reporting of Analytical Data: Precision and accuracy – Types of errors – Ways of expressing precision – Methods to reduce systematic errors.

Units, Significant figures, rounding, Statistical treatment of analytical data, Mean and standard deviation

Separation and Purification Techniques: Recrystallisation, use of drying agents, sublimation. General principles of distillation, fractional distillation, distillation under reduced pressure.

Solvent extraction.

Module 1V: Chromatographic Techniques(6 Hrs)

Chromatography - Principle of differential migration. Classification of chromatographic methods. Basic principle and uses of Thin layer chromatography (TLC), Paper chromatography (PC), R_f value, Column chromatography, Gas chromatography(GC), High performance Liquid chromatography (HPLC), Ion Exchange chromatography (IEC).

TEXTBOOK

1. Ajith James Jose, Saritha Chandran A, Krishnaraj M V, Complementary Chemistry for First Year Students, BrandMithra Publications, Pala, Third edition, 2020.

REFERENCES

1. B. R. Puri, L. R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 3rd edn. Vishal Pub. Co., 2008.
2. C. N. R. Rao, *University General Chemistry*, Macmillan, 2009.
3. Manas Chanda, Atomic Structure and Molecular Spectroscopy.
4. P. L. Soni, Inorganic Chemistry.
5. R. A. Day Junior, A.L. Underwood, *Quantitative Analysis*, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988.
6. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, *Vogel's Text Book ofQuantitative Chemical Analysis*, 6th edn. Pearson Education (2003).
7. R. Gopalan, *Analytical Chemistry*, S. Chand and Co., New Delhi.

MODEL QUESTION PAPER

B.Sc. DEGREE (C.B.C.S. S.) EXAMINATION, NOVEMBER 2023
SEMESTER I - CHEMISTRY COMPLEMENTARY COURSE

CH1B01B23: BASIC THEORETICAL AND ANALYTICAL CHEMISTRY

[Common for students who have opted Botany, Zoology, Home science as Core]

Time: 3 hrs **Maximum marks: 60**

Part A
(Answer any ten questions. Each question carries 1 mark)

Qn.No.	Questions	CO	Level of question
1.	State Heisenberg's Uncertainty principle	**1**	**R**
2.	Cite two examples for intramolecular hydrogen bonding.	**1**	**U**
3.	Recall dipole-dipole interaction.	**1**	**R**
4.	Define periodicity in properties.	**2**	**R**
5.	Identify the nature of bond formed when the difference in electronegativities between two elements in a bond is less than 1.7.	**2**	**U**
6.	Define one atomic mass unit.	**2**	**R**
7.	Cite any two examples of a secondary standard in titrimetric analysis.	**3**	**U**
8.	Identify a substance which can act as a self-indicator in redox titration.	**3**	**U**
9.	Define equivalence point of titration.	**3**	**R**
10.	Cite an example for an adsorbent in adsorption chromatography	**4**	**U**
11.	Define the term elution in column chromatography	**4**	**R**
12.	Cite two examples for cation exchange resin.	**4**	**U**

(10 × 1=10 marks)

PART B
(Answer Any 6 Questions. Each Question Carries 5 Marks)

Qn.No.	Questions	CO	Level of question
13	Differentiate between orbit and orbital.	**1**	**U**
14	Explain Aufbau principle and Hund's rule of maximum multiplicity.	**1**	**U**
15	Differentiate between valency and oxidation number.	**2**	**U**
16	Calculate the concentration of H_3O^+ ions and OH- ions in a) 0.001 M solution of HCl b) 0.005 M solution of Ba(OH)2 at 298 K, assuming that HCl and Ba(OH)2 are completely ionised under the given conditions.	**2**	**Ap**
17	Explain primary and secondary standards. Discuss the criteria for a substance to qualify as a primary standard. Give any two examples of primary standard.	**3**	**U**
18	Discuss the different ways of expressing precision.	**3**	**U**

19	Compare cation and anion exchange resins with examples.	**4**	**U**
20	Discuss the main components of Gas Liquid Chromatography (GLC) apparatus.	**4**	**U**
21	Explain the determination of Rf value in TLC with the help of a diagram.	**4**	**U**

(6× 5 = 30 marks)

PART C

(Answer any 2 questions. Each question carries 10 marks)

Qn.No.	Questions	CO	Level of question
22	Explain the merits and demerits of Bohr atom model.	**1**	**U**
23	a) Illustrate different types of overlapping in the formation of single and multiple bonds with suitable examples. b)Briefly describe VSEPR theory.	**1**	**U**
24	Explain the applications of solubility product and common ion effect.	**2**	**Ap**
25	Explain the following methods of titration a) redox titrations b) double burette titrations.	**3**	**U**

(2 x 10 = 20 marks)

SEMESTER II

COMPLEMENTARY COURSE

CH2B01B23: BASIC ORGANIC CHEMISTRY

[Common for students who have opted Botany, Zoology, Home science as Core]

Credits – 2

Hours per week: 2 **Total Lecture Hours: 36**

Course Overview and Context

The Course seeks to introduce the topics in chemistry such as IUPAC nomenclature, reaction mechanism, stereochemistry and polymers which are essential basics for students.
Since the course explains the environmental toxicity of polymers, it generates environmental consciousness in students.

Course Outcomes

CO1: Apply the IUPAC nomenclature to name and write the structure of organic compounds including stereoisomers.**(Apply)**

CO2: Explain the types of reagents, reactive intermediates, reaction mechanisms and the corresponding influencing factors in organic chemistry.**(Apply)**

CO3: Explain stereoisomerism in organic chemistry. **(Understand)**

CO4: Explain the classification, structure, properties, methods of preparation, uses and environmental toxicity of polymers. **(Understand)**

Syllabus Content

Module I: Fundamental Concepts of Organic Chemistry (9 Hrs)

Introduction: Origin of organic chemistry – Uniqueness of carbon – Homologous series. IUPAC nomenclature of alkyl halides, alcohols, aldehydes, ketones, carboxylic acids and amines. Structural isomerism: Chain isomerism, position isomerism, functional isomerism, metamerism and tautomerism. Bond fission - homolytic and heterolytic fission. Types of reagents - Electrophiles and nucleophiles. Polarity of bonds. Reaction Intermediates: Carbocations, carbanions and free radicals (Structure and stability). Types of organic reactions: Addition, Elimination, Substitution and Rearrangement (definition and one example each).

Module II : Mechanisms of Organic Reactions (9 Hrs)

Meaning of reaction mechanism. Polarity of bonds. Electron Displacement Effects: Inductiveeffect - Definition - Examples - +I and -I groups. Applications: Explanation ofsubstituent effect on the acidity of aliphatic carboxylic acids. Mesomeric effect: Definition –Characteristics - +M and -M groups, Applications. Hyperconjugation: Definition – Characteristics. Applications: Baker-Nathan effect, Comparison of stability of 2-methyl-1-butene & 2-methyl-2-butene. Steric effect (causes and simple examples).

Substitution reactions: Nucleophilic substitution of alkyl halides- S_N1 and S_N2 mechanisms.Electrophilic substitutions in benzene.

Addition reactions: Electrophilic addition to alkene - Markwonikoff's rule, Peroxide effect.
Elimination reactions: E1 and E2 mechanisms. (General mechanism is only needed)

Module III: Stereochemistry of Organic Compounds (9 Hrs)

Stereosiomerism– definition, classification.

Geometrical Isomerism: Definition – Condition – Geometrical isomerism in but-2-ene andbut-2-ene-1,4-dioic acid. cis and trans, *E* and *Z* configurations. Methods of distinguishing and interconversion of geometrical isomers.

Conformations: Newman projection, Saw-horse projection. Conformations of ethane.

Optical Isomerism: Optical activity – Chirality – Enantiomers - Meso compounds - Diastereoisomers – Optical isomerism in lactic acid and tartaric acid - Racemisation and resolution (elementary idea only).

Module IV: Natural and Synthetic Polymers (9 Hrs)

Introduction. Classification of polymers: Natural, synthetic; linear, cross-linked and network; plastics, elastomers, fibres; homopolymers and copolymers. Polymerization reactions. Typical examples: Polyethylene, polypropylene, PVC, phenol-formaldehyde and melamine-formaldehyde resins, polyamides (nylons) and polyesters. Natural rubber: structure, latex processing methods, vulcanization and uses. Synthetic rubbers: SBR, nitrile rubber and neoprene. Biodegradability of polymers, environmental hazards.

TEXTBOOK

1. Ajith James Jose, Saritha Chandran A, Krishnaraj M V, Complementary Chemistry for First Year Students, BrandMithra Publications, Pala, Third edition, 2020.

REFERENCES

1. I. L. Finar, Organic Chemistry Vol. I , 6th edn. Pearson.
2. M.K. Jain, S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co. 2010.
3. S. M. Mukherji, S. P Singh, R. P Kapoor, Organic Chemistry Vol.1, New Age International Pvt. Ltd, 2006.
4. S. Sengupta, Basic Stereochemistry of Organic Molecules, 2014.
5. E. L. Eliel, S.H. Wilen, *Stereochemistry of Organic Compounds*, Wiley, 1994.
6. Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, 6th edn. Orient Longman, 1988.
7. S. M. Mukherji, S.P Singh, *Reaction Mechanism in Organic Chemistry*, Macmillan, 3rdedn., 2003.
8. V.R. Gowarikar, N.V. Viswanathan, J. Sreedhar, *Polymer Science*, 2ndedn., New Age International Pvt. Ltd., 2015.

SEMESTER I AND II

COMPLEMENTARY COURSE

[Common for students who have opted Botany, Zoology, Home science as Core]

CH2BP01B23: VOLUMETRIC ANALYSIS

Credits – 2

Hours per week: 2 **Total Hours: 72**

Course Context and Overview

The course gives hands on training in weighing and preparation of standard solutions, estimation of analyte using acidimetry, alkalimetry, permanganometry, dichrometry–iodimetry, iodometry- and complexometriy.

The Course enables students to acquire skills in chemical analysis through volumetric titrations. The course enhances the job opportunities of students as chemical analysts.

The course generates environmental consciousness in students by introducing them to microanalysis where reduced amounts of chemicals are used for analysis and hence pollution due to drainage of chemicals is greatly reduced.

Course Outcomes:

CO1: Prepare standard solutions for microscale volumetric analysis. (**Apply**)

CO2: Record the molarity of the given intermediate solution by standardizing it. (**Apply**)

CO3: Calculate the mass of the analyte in a given solution by microscale volumetric analysis. (**Apply**)

CO4: Administer microscale analysis of solutions by different types of volumetry like acidimetry, alkalimetry, permanganometry, dichrometry, iodometry and iodimetry. (**Apply**)

Syllabus Content

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

TEXTBOOK

1. Saritha Chandran A, Sicily Rilu Joseph, Lab Manual on Microscale Volumetric Analysis For Complementary Chemistry, Teresian Publishing House, St. Teresa's College (Autonomous), Ernakulam, Second edition 2021.

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., Pearson Education. Ltd.
3. G. D. Christian, *Analytical Chemistry*, JohnWiley and Sons
4. R.D Day, A.L. Underwood, *Quantitative Analysis*, 6thEdn., Prentice Hall of India Pvt. Ltd.

SEMESTER III

CH3B01B23: INORGANIC AND ORGANIC CHEMISTRY

[Common for students who have opted Botany, Zoology, Home science as Core]

Credits – 3

Hrs per week: 3 **Total Lecture Hours: 54**

Course Overview and Context

This course deals with nuclear chemistry, agricultural chemistry, different types of pesticides, heterocyclic compounds, drugs, food additives and cosmetics.

Course Outcome

CO1: Explain the nuclear stability, fission and fusion processes and applications of radioactive isotopes. (**Apply**)

CO2: Summarize the biochemical reactions taking place during photosynthesis and respiration and the role of metal ions in biological processes. (**Understand**)

CO3: Explain the classification, uses and toxic effects of drugs, cosmetics, food additives, fertilizers and pesticides. (**Understand**)

CO4: Illustrate the preparation, properties, structure and aromaticity of furan, pyrrole and pyridine. (**Apply**)

Syllabus Content

Module I : Nuclear Chemistry (12 Hrs)

Nuclear Stability - Mass defect, Binding energy, Nuclear forces, Magic number, Packing fraction, n/p ratio. Natural and 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 radioactive isotopes – ^{14}C dating – Rock dating – Isotopes as tracers – Radio diagnosis and radiotherapy.

Module II: Bioinorganic Chemistryand Agricultural Chemistry (18 Hrs)

Bioinorganic Chemistry: Thermodynamics of Living cell- Exergonic and endergonic reactions. Metal ions in biological systems - Biochemistry of iron – Metalloporphyrins - Haemoglobin and myoglobin, pH of blood, cytochromes, Ferredoxine - Mechanism of $O_2$and CO_2 transportation - Chlorophyll and photosynthesis (mechanism not expected) elementary idea of photophosphorylation. Photosynthesis and respiration – comparison. – Elementary idea of structure and mechanism of action of sodium potassium pump. Biochemistry of zinc and cobalt.

*Chemistry and Agriculture:*Fertilizers -NPK, superphosphates, triple super phosphate, uses of mixed fertilizers,micronutrients and their role, bio-fertilizers, plant growth hormones.

Pesticides -Classifications with simple examples, Biopesticides. Insecticides – stomachpoisons, contact insecticides, fumigants. Method of preparation and use of DDT. Herbicides - function of 2, 4,-D and 2,4,5 –T, Fungicides - inorganic and organic- Bordeaux mixture. Excessive use of pesticides – environmental hazards.

Module III : Heterocyclic Compounds (8 Hrs)

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

Module IV: Drugs (8 Hrs)

Classification of drugs. Structure, therapeutic uses and mode of action (synthesis not required) of Antibiotics: Ampicillin, Sulpha drugs: Sulphanilamide, Antipyretics: Paracetamol, Analgesics: Aspirin, Antacids: Ranitidine, Antimalarials: Chloroquine and Anti-cancer drugs: Chlorambucil. Psychotropic drugs: Tranquilizers, antidepressants and stimulants with examples. Drug addiction and abuse. Prevention and treatment.

Module V: Food Additives and Cosmetics (8 Hrs)

Food Additives: Food preservatives, artificial sweeteners, flavours, emulsifying agents,antioxidants, leavening agents and flavour enhancers (definition and examples, structures not required) – Structure of BHT, BHA and MSG - Commonly used permitted and non-permitted food colours (structures not required) - Fast foods and junk foods & their health effects – Soft drinks and their health effects.

Cosmetics: Introduction. Dental cosmetics, Shampoos, Hair dyes, Skin products, Shaving cream, Talcum powder, Perfumes and Deodorants (health effects).

TEXTBOOK

1. Ajith James Jose, Saritha Chandran A, Krishnaraj M V, Complementary Chemistry for Life Science Students, III Semester, BrandMithra Publications, Pala, Second edition, 2019.

REFERENCES

1. H.J. Arnikar, *Essentials of Nuclear Chemistry* (Revised IV edn.),New Age, 1995.
2. B. R. Puri, L. R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 3rd edn. Vishal Pub. Co., 2008.
3. I. L. Finar, *Organic Chemistry* Vol. 1 & 2, 6th edn., Pearson, 2002.
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5. B. R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers New Delhi. 2013.
6. G. R. Chatwal, *Synthetic Drugs*, Himalaya Publishing House, Bombay, 1995.
7. J.Ghosh, *A Textbook of Pharmaceutical Chemistry*, S. Chand & Co Ltd., 1997
8. B. Sreelakshmi, *Food Science*, New Age International Pvt. Ltd, New Delhi, 2015.
9. J.W. Hill, T.W. McCreary, D.K. Kolb, *Chemistry for Changing Times*, Prentice Hall, 12^{th}edn., 2010.

SEMESTER IV

COMPLEMENTARY COURSE

CH4B01B23: ADVANCED BIO-ORGANIC CHEMISTRY

[Common for students who have opted Botany, Zoology, Home Science as Core]

Credits - 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Context:

Enzymes, Nucleic acids & Vitamins, Amino acids and proteins, Carbohydrates, Lipids, Fats &Oils, steroid and hormones.

Course Outcomes

CO1: Summarize the classification, isolation and properties of essential oils, alkaloids and lipids. (**Understand**)

CO2: Explain the structure, classification and biological functions of Amino acids, proteins, enzymes, nucleic acids, vitamins, steroids and hormones. (**Apply**)

CO3: Summarize the preparation, properties and configuration of glucose, fructose, sucrose, starch and cellulose. (**Understand**)

CO4: Explain the classification, cleaning action and environmental effects of soaps and detergents. (**Understand**)

Syllabus Content

Module I : Natural Products(12 Hrs)

Terpenoids: Classification with examples – Isoprene rule – Isolation of essential oils bysteam distillation – Uses of lemongrass oil, eucalyptus oil and sandalwood oil - Source, structure and uses of citral and geraniol.

Alkaloids: Classification – Isolation, general properties. Source, structure and physiologicalactivity of nicotine, coniine and piperine.

Lipids: Classification – Oils, fats and waxes (definition, structure, biological functions andexamples). Hydrogenation and Rancidity - Acid value, Saponification value and Iodine value –. Biological functions of phospholipids and glycolipids

Soaps and Detergents: Soaps – Types of soaps. Cleansing action of soaps. Syntheticdetergents - Classification. Comparison between soaps and detergents. Environmental aspects.

Module II: Amino Acids and Proteins (12 Hrs)

Amino acids: Classification – Zwitter ion formation and isoelectric point- Synthesis ofglycine, alanine, and phenyl alanine (any one method). Peptides: Peptide bond. Synthesis of peptides (upto dipeptides). Proteins: Classification of proteins – Primary, secondary and tertiary structure of proteins -– Denaturation of proteins – Tests for proteins.

Module III : Enzymes and Nucleic Acids (9 Hrs)

Enzymes: Nomenclature, classification and characteristics. Mechanism of enzyme

action.Theory of enzyme catalysis – Michaelis-Menten theory. Cofactors and coenzymes. Enzyme inhibitors. Uses of enzymes.

Nucleic acids: Structure of pentose sugar, nitrogenous base, nucleoside and nucleotide – Double-helical structure of DNA – Differences between DNA and RNA. Biological Functions – Replication and protein biosynthesis. Transcription and Translation. Genetic code.

Energy rich molecules: Elementary structure of ATP, ADP and AMP.

Module IV : Carbohydrates (12 Hrs)

Classification with examples. Preparation and properties of glucose, fructose and sucrose. Cyclic structures and Haworth projections of glucose, fructose, maltose and sucrose (ring size determination not expected). – Mutarotation. Conversion of glucose to fructose and vice versa. – Structure of starch and cellulose (structure elucidation not expected). Industrial applications of cellulose.

Module V: Vitamins, Steroids and Hormones (9 Hrs)

Vitamins: Classification. Structure, biological functions and deficiency diseases of vitaminsA, B_1, B_2, B_3, B_5, B_6, B_{12} (structure not required), C and D.

Steroids: Introduction. Structure and functions of cholesterol. Elementary idea of HDL andLDL. Bile acids.

Hormones: (only examples and biological functions needed. Structures are not needed.)Introduction. Steroid hormones, peptide hormones and amine hormones(examples, endocrine gland and biological functions, structure not required). Artificial hormones (elementary study only).

TEXTBOOK

1. Ajith James Jose, Saritha Chandran A, Krishnaraj M V, Advanced Bio Organic Chemistry, BrandMithra Publications, Pala, Second edition, 2019.

REFERENCES

1. Maya Shankar Singh, L.G.Wade, *Organic Chemistry*, 6th Edition, Pearson Education, New Delhi, 2013.
2. P.Y. Bruice, *Essential Organic Chemistry*, 1st Edition, Pearson Education, New Delhi, 2013.
3. I.L. Finar, *Organic Chemistry Vol. I & II*, 5th Edition, Pearson Education, New Delhi, 2013.
4. M.K. Jain, S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co. 2010.
5. K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra, *A Textbook of Organic Chemistry*, 2nd Edition, Vikas Publishing House (P) Ltd., New Delhi, 2004.
6. A. Bahl and B.S. Bahl, *Advanced Organic Chemistry*, 1st Multicolour Edition, S. Chand & Company, New Delhi, 2010.
7. A.C. Deb, *Fundamentals of Biochemistry*, 9thEdn. New Central Book Agency,2001.
8. Rastogi, *Biochemistry*, Tata McGraw –Hill Publication ,1996.
9. Bhat S.V., Nagasampagi, B.A. &Sivakumar M. *Chemistry of Natural Products*, Narosa, 2005.

SEMESTER III AND IV

COMPLEMENTARY COURSE

[Common for students who have opted Botany, Zoology, Home science as Core]

CH4BP01B23: ORGANIC CHEMISTRY PRACTICALS (MICRO)

Credit – 2

Hours per week: 2 **Total Hours: 72 Hrs**

Course Overview and Context

To analyze and confirm the functional groups after detecting the hetero atoms, saturation/unsaturation, aromatic/aliphatic and preparation of solid derivatives.

The course provides skill development in analysing various classes of organic compounds, which will be useful in the synthetic organic chemistry and pharmaceutical chemistry, nutritional chemistry.

Course Outcomes

CO1: Determine the heteroatoms present in an organic compound. (**Apply**)

CO2: Identify the functional groups present in an organic compound. (**Apply**)

CO3: Summarize the method of preparation of solid derivative of the analysed organic compound. (**Understand**)

Syllabus Content

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, α-naphthol, β-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. (minimum of ten compounds to be analysed).
5. Organic preparation involving halogenation, nitration, oxidation, reduction, acetylation, benozylation, hydrolysis, diazotization. (non- evaluative)
6. Isolation of an organic compound from a natural source. (non- evaluative)

TEXTBOOK

1. Maria Thomas, Chemistry- A Practical Book for Volumetric Analysis and Microscale Organic Compound analysis, First Edition, 2019.

REFERENCES

1. A. I Vogel, A Text Book of Practical Organic Chemistry, Longman.
2. F. G. Mann and B.C. Saunders, Practical Organic Chemistry, 4th Edn., Pearson Education.
3. V. K. Ahluwalia and S. Dhingra, Comprehensive Practical Organic Chemistry, Universities Press.