ST.TERESA'S COLLEGE (AUTONOMOUS)

ERNAKULAM

(Affiliated to Mahatma Gandhi University, Kottayam)

CURRICULUM AND SYLLABI FOR

BACHELOR'S PROGRAMME IN CHEMISTRY

AND

SYLLABI FOR COMPLEMENTARY COURSES IN

CHEMISTRY

Under Choice Based Credit & Semester System

(2018 Admissions)

Department of Chemistry

Board of Studies in Chemistry

Sl No.	Name of the member	Official Address	Designation
1	Dr. Geetha Andrews	Associate Professor, Department of Chemistry, St.Teresas's College Ernakulam.	Chairman
2.	Dr. Sunil K Narayanankutty	Controller of Examination, Cochin University of Science and Technology, Cochin- 22.	Subject expert
3.	Dr. Beena Mathew	Professor & Director of School of Chemical Science, Mahatma Gandhi University, Kottayam- 686560	Expert from outside
4.	Dr. Anantha Padmanabhan	Associate Professor, Maharaja's College, Ernakulam	Subject Expert.
5.	Dr. Babu V	Scientist , R & D division, HIL Limited, Udyogamandal P.O Eloor	Expert from the Industry
6.	Prof. Roseline P J	Associate Professor (Rtd), St. Joseph's College, Alleppey, Thevarparambil, Mathai Manjooran Road, Pachalam P O - 682012	Alumnus
7.	Dr. Ushamani M.	Assistant professor , HOD, Department of Chemistry, St.Teresa's College Ernakulam.	Member
8.	Dr. Jaya T. Varkey	Assistant professor , Department of Chemistry, St.Teresa's College Ernakulam.	Member
9.	Dr. Saritha Chandran A.	Assistant professor, Department of Chemistry, St.Teresa's College Ernakulam.	Member
10.	Dr. Elizabeth Kuruvilla	Assistant professor, Department of Chemistry, St.Teresa's College Ernakulam.	Member

PREFACE

As an autonomous college under Mahatma Gandhi University, St. Teresa's College has taken conscientious efforts to strengthen the curriculum by retaining all the fundamental stipulations of the University/Higher Education Council, to ensure a well-balanced Curriculum. Within the constraints of a prescribed syllabus, we have resolved to take a collective effort to create an inspiring academic culture in the institution, essential for teachers and students to access deeper knowledge and participate in its expansion and transmission. It is also to re-articulate the almost lost or forgotten fact that production and transmission of Quality Knowledge, essential for the development of students in particular and society in general, are the primary functions of any Educational Institution.

The Syllabus restructuring of 2018 aims to provide the students many opportunities to engage with authentic, real world learning. This has been evident through the significant number of new Programmes introduced at the wake of autonomy in 2014 with their integral placement opportunities. Increasingly, however, opportunities for engagement in work-based learning that can be provided through the curriculum across a range of subject areas are creating new and exciting ways to support student learning.

I acknowledge the efforts taken by the teachers in developing Programme and Course outcomes that focus on cognitive and intellectual skills of the learners ,confidence to carry out independent and scholarly research in area of professional interest to them and to position themselves globally effective cross- cultural educators .

I congratulate the efforts taken by the Principal Dr. Sajimol Augustine M. and the team for restructuring the syllabi under the leadership of Smt. Shanty B.P in a meaningful manner. Transformation is what makes St. Teresa's distinctive. Transforming lives in order to make a real impact on the local and international stage through the creation, sharing and application of knowledge. We look forward to sharing with you the outcomes of our curriculum restructuring and these resources we hope will enable you to reflect on learning gain in our own institution.

DR. SR. VINITHA (CELINE E)

DIRECTOR.

FOREWORD

Autonomy in the field of higher education implies responsibility and accountability and this in turn leads to excellence in academics and pro active governance. St Teresa's College was given autonomous status in the year 2014 and we have made a concerted attempt to maintain a high level of quality in the standard of education that we impart.

Academic autonomy has granted us the freedom to fine tune the syllabus keeping in mind the changing needs of the new generation of students. 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. Structured feedback was taken from the Students, Alumni and the experts from the industry and the changes suggested by them were duly incorporated in the syllabi.

The Board of Studies constituted for each department meet regularly in the stipulated time frame and in depth discussions are conducted about the different dimensions of the curricula and syllabi. The IQAC team has felicitated the conduct of a number of workshops and conferences to equip the faculty with the necessary skill set to frame the syllabi, set question papers for internal tests that evaluate whether the learning outcomes enlisted in the syllabus have been achieved and to ensure the fair and transparent conduct of examinations.

The responsibility that autonomy has placed on us is indeed onerous but we have strived together to meet all the challenges that were placed in our way. We have worked towards moulding young women as responsible citizens who will carry forward the task of nation building in an exemplary manner. All effort has been made to nurture their academic ambitions as well as their skills in co curricular activities.

With sincere gratitude I acknowledge the instinct support and constant guidance extended byRev. Sr. Dr. Vinitha, the Director of the College.

I specially thank the team headed by Smt. Shanty B. P for updating the *syllabi*, the Heads of the Departments and all the faculty members for their diligence, commitment and exceptional contribution towards this endeavour.

DR. SAJIMOL AUGUSTINE. M
PRINCIPAL

ACKNOWLEDGEMENT

At the outset, I bow my head before the Almighty for His eternal heavenly guidance during the entire process of restructuring. I remember with gratitude the support of our Director, Rev.(Dr).Sr.Vinitha, Principal, Dr.Sajimol Augustine. M and the members of syllabus revision committee during the syllabus restructuring process. I am also grateful to all the esteemed members of the Board of Studies, Dr. Sunil K Narayanankutty, Dr. Anantha Padmanabhan, Dr. Beena Mathew, Dr. Babu V, Prof. Roseline P. J., the HOD of the Department of Chemistry, Dr. Ushamani M and faculty members of the department Dr. Jaya T. Varkey, Dr. Saritha Chandran .A and Dr. Elizabeth Kuruvilla for their constructive suggestions and contributions. Expressing my deep sense of gratitude also to Mr. Geogy Alex, Associate professor, St. Thomas College, Palai, whose inspiring sessions gave us valuable inputs regarding syllabus restructuring. Above all, I am deeply indebted to all the young and vibrant colleagues in the Department of Chemistry for the long and arduous work they have put in during the compiling of the restructured syllabus.

Dr. Geetha Andrews
Chairperson,
Board of Studies in Chemistry,
St. Teresa's College (Autonomous).

CONTENTS

B.Sc. Programme in Chemistry under choice based credit and semester system (2018 admission onwards)

PREAMBLE

The B.Sc.Chemistry course 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 over burdened 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.

GRADUATE ATTRIBUTES

1. Knowing chemistry as a fundamental branch of Science
2. Familiarization with theoretical and analytical sampling procedures
3. Laying the foundation of higher studies in interdisciplinary scientific study
4. Awareness about the environment and the threats it faces
5. Improving scientific writing and presentation skills
6. Learning team work and team resource utilization
7. Improvisation of practical skills
8. Safety in the lab
9. Inter disciplinary collaborations through project work
10. ICT enabled learning
11. Self study using print media
12. Learning the ways and means to mitigate the effects of pollution
13. Developing global citizenship concepts by electronic interaction with communities across the world.
14. Helping the slow learners through group works
15. Cautious handling of diverse chemicals.
16. Spectroscopic studies
17. Studies on nuclear safety aspects
18. Learning the industrial applications of the course content

AIMS AND OBJECTIVES

The Faculty of Science, St.Teresa's College Ernakulam and Board of Studies in Chemistry (UG) recognizes that curriculum, course content and assessment of scholastic achievement play complementary roles in shaping education. The committee is of the view that assessment should support and encourage the broad instructional goals such as basic knowledge of the discipline of Chemistry including theories and techniques, concepts and general principles. This should also support the ability to ask questions and to obtain solutions by use of qualitative and quantitative reasoning and by experimental investigation. The important student attributes including keen observation, curiosity, creativity and reasoned skepticism and understanding links of Chemistry to other disciplines and to societal issues should be given encouragement. With this in mind, we aim to provide a firm foundation in every aspect of Chemistry and to explain a broad spectrum of modern trends in chemistry and to develop experimental, computational and mathematics skills of students.

The programme also aims to develop the following abilities:

1. Read, understand and interpret chemical information – verbal, mathematical and graphical.
2. Impart skills required to gather information from resources and use them.
3. To give need based education in chemistry of the highest quality at the undergraduate level.
4. Offer courses to the choice of the students.
5. Perform experiments and interpret the observed results.
6. Provide an intellectually stimulating environment to develop skills and enthusiasms of students to the best of their potential.
7. Use Information Communication Technology to gather knowledge at will.
8. Attract outstanding students from all backgrounds.

OBJECTIVES:

The syllabi are framed in such a way that it bridges the gap between the plus two and post graduate levels of Chemistry by providing a more complete and logical framework in almost all areas of basic Chemistry.

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 and (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 and Complementary courses including Project	79
F	Credits required from Open Course	3
G	Minimum attendance required	75%

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:

Model – I	
Courses	**Number**
Common Courses	10
Core Courses (Theory)	12
Project/ Industrial Visit and comprehensive viva	1
Core practical	**6**
Open Course	1
Choice based Course	1
Complementary Courses	10
Total	**41**

COURSES WITH CREDITS

For MODEL 1

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

COURSE CODE FORMAT

The programme is coded according to the following criteria.

1. The first letter plus second letter from the name of the programme ie., **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 core course, **C** for Complementary course, **D** for Open course, ie.., **CH1B (Chemistry, 1st semester Core course)** and **PR** for project.
4. Two digits to indicate the course number of that semester. ie.., **CH1B01 (Chemistry, 1st semester, Core course, course number is 01)**
5. The letter **B** to indicate Bachelors Programme.
6. **CH1B01B** (Chemistry, 1st semester, Core course, courses number 01, and **B** for bachelors Programme)
7. **18 to indicate the year.** ie.., **CH1B01B18**
8. The letter **P** denotes practical – it should come after the code letter for the course ie…,**BP** (core practical-eg. **CH2BP01B18**)/**CP**(complementary practical-eg. **CH2CP01B18**)
9. Chemistry Project: **CH6BPRB18**

SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS FOR CORE COURSES

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

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	EN1A01B18	FINE-TUNE YOUR ENGLISH	5	4	20	80
		EN1A02B18	PEARLS FROM THE DEEP	4	3	20	80
	Common course II	MA1A01B18	KATHASAHITHYAM	4	4	20	80
		HN1A01B18	KAHAANI AUR UPANYAS			20	80
		FR1A01B18	FRENCH LANGUAGE AND COMMUNICATIVE SKILLS -I			20	80
	Complementary course I	MT1C01B18	CALCULUS	4	3	20	80
	Complementary course II	PH1C02B18	PROPERTIES OF MATTER & THERMODYNAMICS	2	2	15	60
	Complementary Practical	PH2CP02B18	PRACTICAL	2	-	-	-
	Core course	CH1B01B18	GENERAL AND ANALYTICAL CHEMISTRY	2	2	15	60
	Core Practical	CH2BP01B18	VOLUMETRIC ANALYSIS	2	-	-	-
			TOTAL CREDITS	-	**18**	-	-
II	Common course I	EN2A03B18	ISSUES THAT MATTER	5	4	20	80
		EN2A04B18	SAVOURING THE CLASSICS	4	3	20	80
	Common course II	MA2A03B18	KAVITHA	4	4	20	80
		HN2A03B18	KAVITA VYAKARAN AUR ANUVAD			20	80
		FR2A03B18	FRENCH LANGUAGE AND COMMUNICATIVE SKILLS-II			20	80
	Complementary course I	MT2C01B18	PARTIAL DERIVATIVES, MULTIPLE INTEGRALS TRIGONOMETRY AND MATRICES	4	3	20	3
	Complementary course II	PH2C02B18	MECHANICS AND CRYSTALLOGRAPHY	2	2	15	60
	Complementary Practical	PH2CP02B18	PRACTICAL	2	2	10	40
	Core course	CH2B02B18	THEORETICAL AND INORGANIC CHEMISTRY	2	2	15	60
	Core Practical	CH2BP01B18	VOLUMETRIC ANALYSIS	2	2	10	40
			TOTAL CREDITS	-	**22**	-	-
III	Common course I	EN3A05B18	LITERATURE AND/AS IDENTITY	5	4	20	80
	Common course II	MA3A05B18	DRISYAKALASAHITHYAM			20	80
		HN3A05B18	NAATAK AUR			20	80

			LAMBI KAVITA				
		FR3A05B18	AN ADVANCED COURSE IN FRENCH –I			20	80
	Complementary course I	MT3C01B18	VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND ANALYTIC GEOMETRY	5	4	20	80
	Complementary course II	PH3C02B18	MODERN PHYSICS AND BASIC ELECTRONICS	3	3	15	60
	Complementary Practical	PH4CP02B18	PRACTICAL	2	-	-	-
	Core course	CH3B03B18	ORGANIC CHEMISTRY – I	3	3	15	60
	Core Practical	CH4BP02B18	QUALITATIVE ORGANIC ANALYSIS	2	-	-	-
			TOTAL CREDITS	-	**18**	-	-
IV	**Common course I**	EN4A06B18	ILLUMINATIONS	5	4	20	80
	Common course II	MA4A06B18	MALAYALA GADHYARACHANAKAL	5	4	20	80
		HN4A06B18	GADYA AUR EKANKI			20	80
		FR4A06B18	AN ADVANCED COURSE IN FRENCH –II			20	80
	Complementary course I	MT4C01B18	FOURIER SERIES , PARTIAL DIFFERENTIAL EQUATIONS, NUMERICAL ANALYSIS AND ABSTRACT ALGEBRA	5	4	20	80
	Complementary course II	PH4C02B18	PHYSICAL OPTICS , LASER PHYSICS AND SUPERCONDUCTIVITY	3	3	15	60
	Complementary Practical	PH4CP02B18	PRACTICAL	2	2	10	40
	Core course	CH4B04B18	ORGANIC CHEMISTRY –II	3	3	15	60
	Core Practical	CH4BP02B18	QUALITATIVE ORGANIC ANALYSIS	2	2	10	40
			TOTAL CREDITS	-	**22**	-	-
V	**Core course**	CH5BO5B18	ENVIRONMENTAL STUDIES AND HUMAN RIGHTS	4	4	20	80
		CH5BO6B18	ORGANIC CHEMISTRY - III	3	3	15	60
		CH5BO7B18	PHYSICAL CHEMISTRY - I	2	2	15	60
		CH5BO8B18	PHYSICAL CHEMISTRY – II	2	3	15	60
	Open course	OFFERED BY OTHER DEPARTMENTS	-	4	3	20	80
	Core Practical	CH6BP03B18	QUALITATIVE INORGANIC MICRO ANALYSIS	3	-	-	-
		CH6BP04B18	ORGANIC PREPARATIONS AND LABORATORY TECHNIQUES	2	-		

						-	-
		CH6BP05B18	PHYSICAL CHEMISTRY PRACTICALS	3	-	-	-
	Project	CH6BPRB18	PROJECT	2	-	-	-
			TOTAL CREDITS	-	**15**	-	-
VI	**Core course**	CH6B09B18	INORGANIC CHEMISTRY	3	3	15	60
		CH6B10B18	ORGANIC CHEMISTRY - IV	3	3	15	60
		CH6B11B18	PHYSICAL CHEMISTRY – III	3	3	15	60
		CH6B12B18	PHYSICAL CHEMISTRY – IV	3	3	15	60
			CHOICE BASED COURSE	3	3	20	80
	Core Practical	CH6BP03B18	QUALITATIVE INORGANIC MICRO ANALYSIS	3	2	10	40
		CH6BP04B18	ORGANIC PREPARATIONS AND LABORATORY TECHNIQUES	2	2	10	40
		CH6BP05B18	PHYSICAL CHEMISTRY PRACTICALS	3	2	10	40
		CH6BP06B18	GRAVIMETRIC ANALYSIS	2	2	10	40
	Project	CH6BPRB18	PROJECT	-	2	20	80
			TOTAL CREDITS	-	**25**	-	-

Total credits of the programme = 120

CONSOLIDATED SCHEME FOR I TO VI SEMESTERS PROGRAMME STRUCTURE- CORE

1. B.Sc. CHEMISTRY PROGRAMME (MODEL - I)

Course Code	Title of the Course	Category	Hrs per week	Credits
	SEMESTER-1			
CH1B01B18	GENERAL AND ANALYTICAL CHEMISTRY	Core	2	2
CH2BP01B18	VOLUMETRIC ANALYSIS	Core	2	-
	Total Credits		**2**	
	SEMESTER-2			
CH2B02B18	THEORETICAL AND INORGANIC CHEMISTRY	Core	2	2
CH2BP01B18	VOLUMETRIC ANALYSIS	Core	2	2
	Total Credits		**4**	
	SEMSTER-3			
CH3B03B18	ORGANIC CHEMISTRY – I	Core	3	3
CH4BP02B18	QUALITATIVE ORGANIC ANALYSIS	Core	2	-
	Total credits		**3**	
	SEMESTER-4			
CH4B04B18	ORGANIC CHEMISTRY –II	Core	3	3
CH4BP02B18	QUALITATIVE ORGANIC ANALYSIS	Core	2	2
	Total Credits		**5**	
	SEMESTER-5			
CH5BO5B18	ENVIRONMENTAL STUDIES AND HUMAN RIGHTS	Core	4	4
CH5BO6B18	ORGANIC CHEMISTRY – III	Core	3	3
CH5BO7B18	PHYSICAL CHEMISTRY - I	Core	2	2
CH5BO8B18	PHYSICAL CHEMISTRY – II	Core	2	3
Offered by other departments	OPEN COURSE	Open	4	3
CH6BP03B18	QUALITATIVE INORGANIC MICRO ANALYSIS	Core	3	-
CH6BP04B18	ORGANIC PREPARATIONS AND LABORATORY TECHNIQUES	Core	2	-
CH6BP05B18	PHYSICAL CHEMISTRY PRACTICALS	Core	3	-
CH6BPRB18	Project/Practical	Core	2	-
	Total Credits		**15**	
	SEMESTER-6			
CH6B09B18	INORGANIC CHEMISTRY	Core	3	3
CH6B10B18	ORGANIC CHEMISTRY – IV	Core	3	3
CH6B11B18	PHYSICAL CHEMISTRY – III	Core	3	3

CH6B12B18	PHYSICAL CHEMISTRY – IV	Core	3	3
	CHOICE BASED COURSE	Core	3	3
CH6BP03B18	QUALITATIVE INORGANIC MICRO ANALYSIS	Core	3	2
CH6BP04B18	ORGANIC PREPARATIONS AND LABORATORY TECHNIQUES	Core	2	2
CH6BP05B18	PHYSICAL CHEMISTRY PRACTICALS	Core	3	2
CH6BP06B18	GRAVIMETRIC ANALYSIS	Core	2	2
CH6BPRB18	Project/ Industrial visit	Core	-	2
	Total Credits	**25**		

OPEN COURSES

Sl. No.	Semester	Course Code	Course Title
1	V	CH5D01aB18	CHEMISTRY IN EVERYDAY LIFE
2	V	CH5D01bB18	NANOSCIENCE AND NANOTECHNOLOGY
3	V	CH5D01cB18	FORENSIC SCIENCE

CHOICE BASED COURSES

Sl. No.	Semester	Course Code	Course Title
1	VI	CH6B13aB18	NANOCHEMISTRY AND NANOTECHNOLOGY
2	VI	CH6B13bB18	POLYMER CHEMISTRY
3	VI	CH6B13cB18	SOIL AND AGRICULTURAL CHEMISTRY

Complementary courses offered by the Department

[For Bachelor programme in Botany, Zoology, Family & Community Science (Home Science) as core]

A. Theory & Practicals

Course Code	Title of the Course	Hrs per week	Credits
	SEMESTER 1		
CH1C01B18	BASIC THEORETICAL AND ANALYTICAL CHEMISTRY	2	2
CH2CP01B18	VOLUMETRIC ANALYSIS	2	-
	SEMESTER 1I		
CH2C01B18	BASIC ORGANIC CHEMISTRY	2	2
CH2CP01B18	VOLUMETRIC ANALYSIS	2	2
	SEMESTER 1II		
CH3C01B18	INORGANIC AND ORGANIC CHEMISTRY	3	3
CH4CP01B18	ORGANIC CHEMISTRY PRACTICALS	2	-
	SEMESTER 1V		
CH4C01B18	ADVANCED BIO-ORGANIC CHEMISTRY	3	3
CH4CP01B18	ORGANIC CHEMISTRY PRACTICALS	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/Seminar/Viva	5
Test papers (2 x 5)	10
Total	20

Attendance:

% of Attendance	Marks
>90%	5
Between 85 and 90	4
Between 80 and 85	3
Between 75 and 80	2
75 %	1
< 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/Seminar/Viva	**2**
Test papers (2 x 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 x 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.

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

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester for all courses.

SEMINAR / VIVA

A student shall present a seminar in the 5th semester and appear for Viva- voce in the 6th semester for all courses.

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 objective type 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 type)	12	10	10 x 1 = 10	10 x 2 = 20
B(Short Essay)	9	6	6 x 5 = 30	6 x 5 = 30
C(Long Essay)	4	2	2 x 10 =20	2 x 15 = 30

CONDUCT OF PRACTICAL EXAMINATIONS

PRACTICAL EXAMINATION

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

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

PASS CRITERIA:

- 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.
- For a pass in a programme, a separate minimum of Grade D is required for all the individual courses.
- If a candidate secures F Grade for any one of the courses 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.
- 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 Grade Point Average (SGPA) of a semester:

$$SGPA = TCP/TC$$

TCP = Total Credit Point of that semester

TC = Total Credit of that semester

Cumulative Grade Point Average (CGPA) is calculated:

$$CGPA = TCP/TC$$

TCP = Total Credit Point of that programme

TC = Total Credit of that programme

GRADE POINT AVERAGE (GPA)

GPA of different category of courses viz. Common courses, Complementary courses, Core courses etc. are calculated:

GPA = 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 GPA

GPA	Grade
>9.5	**S - Outstanding**
8.5 – 9.5	**A^+ - Excellent**
7.5 – 8.5	**A - Very good**
6.5 – 7.5	**B^+ - Good**
5.5 – 6.5	**B - Above average**
4.5 – 5.5	**C - Satisfactory**
3.5 – 4.5	**D - Pass**
<3.5	**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 sem 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

SYLLABUS FOR
CHEMISTRY CORE COURSES

SEMESTER I

CH1B01B18: GENERAL AND ANALYTICAL CHEMISTRY

Credits: 2

Total Lecture Hours: 36

Aim of the course: To introduce the methodology of science and so also to give an introductory concepts in periodic properties and analytical chemistry.

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.

Module 1: Methodology of Chemistry and Evaluation of Analytical Data (12 Hrs)

Definition of Science. Scientific methods - observation-posing a question - formulation of hypothesis- experiment – theory - law. Falsification of hypothesis - inductive and deductive reasoning- 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. Structure of chemical science: Scope, theory and experiment - branches of chemistry. Role of chemistry as a central science connecting physics, biology and other branches of science. Interdisciplinary areas involving chemistry: Nanotechnology and biotechnology.

Evaluation of Analytical Data: Units, significant digits, rounding, scientific and prefix notation, graphing of data. Precision and accuracy-types of errors – ways of expressing precision – ways to reduce systematic errors - reporting analytical data. Statistical treatment of analytical data – population and samples –Mean and standard deviation – distribution of random 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. Effective nuclear charge – Slater rule and its applications – polarising power.

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. 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.

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, 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.

Competencies of the course

- Has enabled the students to get an idea about science, scientific methods and evolution of chemistry as a branch of science.
- Has acquired the fundamentals of evaluation of analytical data. .
- Has been able to discuss the concept of periodic table and periodic properties of elements
- Has been able to differentiate between synthetic and analytical methodologies in Chemistry.
- Various scales of electronegativity were discussed
- Different types of titrimetry was discussed
- Theory of qualitative analysis were discussed.
- Gravimetric analysis was taught using iron and barium estimation.

- Titration curves and separation techniques was studied.
- Significance of chromatographic techniques was discussed.

References

- J.A.Lee, Scientific Endeavour, Addison Wesley Longman
- C.N.R.Rao, University General Chemistry, MacMillan India (Ltd.)
- 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.
- J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London, 2010.
- B.R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, 31st Edition, Milestone Publishers and Distributors, New Delhi, 2013.
- Satya Prakash, *Advanced Inorganic Chemistry, Volume 1,* 5th Edition, S. Chand and Sons, New Delhi, 2012.
- 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.
- R. Gopalan, *Inorganic Chemistry for Undergraduates,* Universities Press, Hyderabad, 2009.

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BSc I Semester - Core
CODE: CH1B01B18
COURSE TITLE: GENERAL AND ANALYTICAL CHEMISTRY

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	12	4	2	2	34
II	6	3	3	0	18
III	18	5	4	2	45

Bachelor's Degree in Chemistry (C.B.C.S.S) Examination

Model Question Paper

I SEMESTER-CORE

CH1B01B18: GENERAL AND ANALYTICAL CHEMISTRY

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

PART A

(Answer any 10 questions. Each question carries 1 mark)

1. How many significant figures are there in the number 2.3006 ?
2. "Force is mass multiplied with acceleration" is a …….. statement.
3. What is a hypothesis ?
4. A paradigm shift in science is also known as …….
5. First ionization energy is ……..than second ionization energy.
6. State modern periodic law.
7. Calculate Z_{eff} for the last electron in Na(11) atom and Na^+ ion.
8. Give two examples of primary standard in volumetric analysis.
9. Name an indicator that is used in complexometric titrations.
10. In an acid base titration, end point occurs in the pH range of 3.7 – 3.9. Suggest a suitable indicator for this titration.
11. How will you calculate the R_f value of a component in a mixture using TLC?
12. What are different methods of packing a column?

(10 x 1=10 marks)

PART B
(Answer any 6 questions. Each question carries 5 marks)

13. Distinguish between inductive and deductive reasoning.
14. What are roles of models in science ?
15. What are the different ways by which atomic radius is expressed? What are its strengths and limitations?
16. Define electron gain enthalpy? Why fluorine has unexpectedly low value of electron gain enthalpy than chlorine?
17. Write a note on periodicity in properties such as: Atomic radii, ionic radii, electron affinity, and electro negativity.
18. Explain common ion effect and its applications.
19. What is gravimetric estimation? Explain with suitable example the different steps involved in a gravimetric estimation.
20. How will you eliminate the interfering anions in inorganic qualitative analysis?
21. Write a note on the principle and instrumentation of ion-exchange chromatography.

(6x 5 = 30 marks)

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

22. Discuss the role of chemistry as central science.
23. Give an account of the different types of errors and the methods to reduce them.

24. What is a titration curve? Discuss the titration curve for the neutralization of:
    (i) A strong acid with a strong base
    (ii) A strong acid with a weak base
25. Explain the principle, instrumentation and applications of HPLC.

(2 x 10 = 20 marks)

SEMESTER II

CH2B02B18: THEORETICAL AND INORGANIC CHEMISTRY

Credits - 2
Total Lecture Hours : 36

Aim of the course: To introduce the concepts of atomic structure, nuclear chemistry and chemistry of s, p,d and f block elements.

Course Overview and Context: To familiarize various theories of atomic structure, quantum numbers and their significance. An introduction to chemical bonding – VB and MO theory. It also aim to create awareness about the chemistry of s, p, d and f block elements.

Module 1: Atomic Structure (6 Hrs)

Introduction based on historical development (Dalton's atomic theory, Thomson's atom model Rutherford's atom model) - failure of classical physics – black body radiation - 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 - limitations of Bohr theory. Louis de Broglie's matter waves – wave-particle duality - electron diffraction - Heisenberg's uncertainty principle. Schrödinger wave equation (derivation not expected), wave functions – significance of ψ and ψ^2 – atomic orbitals and concept of quantum numbers - shapes of orbitals (*s*, *p* and *d*) - Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle – electronic configuration of atoms.

Module II : Chemistry of s, p, d & f Block Elements (10 Hrs)

s and p block: Periodicity in s-and p- block elements with respect to electronic configuration, atomic and ionic size, ionization energy and electro negativity. Inert pair effect.

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 $KMnO_4$ and $K_2Cr_2O_7$.

Lanthanides: Electronic configuration and general characteristics – Occurrence of lanthanides. 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 favouring the 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 – shape of molecules ($BeCl_2$, C_2H_2, BF_3, C_2H_4, CH_4, PCl_5, SF_6 and IF_7). VSEPR theory: Postulates - applications - shapes of molecules NH_3, H_2O, XeF_2, IF_5, and XeF_6.

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

Competencies of the course

- Has enabled the students to get an idea about atomic structure and chemical bonding.
- Has acquired the fundamentals of atomic structure**.**
- Enabled the students to understand the chemistry of representative elements
- Compared the properties of lanthanides and actinides
- Bonding in molecules
- Types of bonds
- Compared the relationship between hybridization and shapes of simple molecules
- Justified the properties of compounds using inter and intra molecular hydrogen bonds
- Produced the MO diagrams of homonuclear and heteronuclear diatomic molecules

References

- R.K. Prasad, *Quantum Chemistry*, New Age International, 2001
- McQuarrie, J. D. Simon, *Physical Chemistry – A molecular Approach*, Viva Books.
- I. N. Levine, *Physical Chemistry*, Tata McGraw Hill,
- ManasChanda, *Atomic structure and Chemical bonding in Molecular Spectroscopy"*Tata McGraw Hill.
- J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London.
- B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
- F. A. Cotton, G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd edn., John Wiley.
- B. Douglas, D. Mc Daniel, J. Alexander, Concepts and models in Inorganic Chemistry.
- Satya Prakash, *Advanced Inorganic Chemistry, Volume 1,* 5th Edition, S. Chand and Sons, New Delhi, 2012.
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BSc II Semester - Core

CODE: CH2B02B18

COURSE TITLE: THEORETICAL AND INORGANIC CHEMISTRY

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	6	3	3	0	18
II	10	3	2	2	33
III	20	6	4	2	46

SEMESTER I AND II - CORE CHEMISTRY PRACTICALS

CH2BP01B18 - VOLUMETRIC ANALYSIS

Credits: 2
Total Hours: 72

Micro Analysis

Aim of the course: To gain practical knowledge about various types of titrations and indicators. To prepare standard solutions and solutions of different concentrations from a standard solution.
Course Overview and Context: Weighing and preparation of standard solutions**.** Acid - base titrations**,** Redox titrations – Permanganometry- Dichrometry- Iodimetry and Iodometry- Complexometric titrations.

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

References

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

SEMESTER III

CH3B03B18: ORGANIC CHEMISTRY – I

Credits – 3
Total Lecture Hours: 54

(Reaction mechanisms expected only wherever mentioned)

Aim of the course: To promote understanding of basic facts and concepts and to inculcate interest in Organic Chemistry

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.

Module 1: 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)

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

Alkenes: Preparation - 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: Preparation - 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: Preparation - From alkenes and alcohols. Reactions - Types of aliphatic nucleophilic substitution reactions - S_N1 and S_N2 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 1V: 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.

Competencies of the course

- Basic understanding about the classification and nomenclature of organic compounds.
- Discussion on organic reaction mechanisms.
- Basic awareness about hydrocarbons –its preparation, properties and isomerism.
- Concept of aromaticity
- Theoretical knowledge required for the qualitative analysis of organic compounds
- Introduction to stereoisomerism
- Interpret Geometrical isomerism, optical and conformational isomerism
- Benzenoid and Non – Benzenoid compounds
- Markownikoff's rule and peroxide effect
- Comparison between Electrophiles and Nucleophiles
- Explanation of reactive intermediates
- Differentiate between aryl and alkyl halides

Text Books

- K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House, 2004.
- Arun Bahl and B.S.Bahl 'A Text Book of Organic Chemistry'16th Edition, 2006.

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- Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry*, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
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- Kalsi, P. S. *Stereochemistry - Conformation and Mechanism*; New Age International, 2005.
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BSc III Semester - Core

CODE: CH3B03B18

COURSE TITLE: ORGANIC CHEMISTRY – I

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	12	4	1	1	19
II	15	3	3	1	28
III	12	1	2	1	21
IV	15	4	3	1	29

SEMESTER IV

CH4B04B18: ORGANIC CHEMISTRY –II

Credits – 3
Total Lecture Hours: 54

(Reaction mechanisms expected only wherever mentioned)

Aim of the course: To familiarize the students with various classes of organic compounds and their physical, chemical properties as well as their synthetic applications

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.

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 $LiAlH_4$.

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 α-hydrogen.

(i) Additions reactions - with HCN, ROH, $NaHSO_3$, Grignard reagents and ammonia derivatives.

Aldol, Claisen, Claisen-Schmidt, Knoevenagel and Benzoin condensations (with mechanisms). Cannizzaro reaction, Wittig reaction and Mannich reaction (with mechanisms). Michael addition (with mechanism) (ii) Oxidation reactions - Tollen's and Fehling's tests, Iodoform test, Baeyer-Villiger oxidation (with mechanism) (iii) Reduction reactions - Clemmensen, Wolff-Kishner, Meerwein-Pondorff-Verley, $LiAlH_4$, and $NaBH_4$ reductions (with mechanisms) (iv) Rearrangement reactions - Beckmann, and benzil-benzilic acid rearrangements (with mechanisms).

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.

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.

Competencies of the course

- To study the preparation and properties of closely related organic compounds
- Gain knowledge about synthetic utility of various reactions
- Comparative studies about carbonyl compounds
- To know about various classes of acidic compounds
- Comparison between phenols and alcohols

- Preparation of carboxylic acid derivatives
- Preparation ethers and epoxides,
- Ascending and descending the series
- Comparison of Preparation and properties of various acids
- Summarise the factors affecting the acidity of aliphatic and aromatic carboxylic acids
- Discussed the derivatives of carboxylic acids.
- Comparison of various types of condensation reactions of carbonyl compounds.

Textbooks

- K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House, 2004.
- Arun Bahl and B.S.Bahl 'A Text Book of Organic Chemistry' 16th Edition, 2006.

References

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- Pillai, C.N. *Organic Chemistry*, Universities Press, 2008.
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BSc IV Semester - Core

CODE: CH4B04B18

COURSE TITLE: ORGANIC CHEMISTRY –II

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	16	3	3	1	28
II	20	4	3	2	39
III	12	3	1	1	18
IV	6	2	2	0	12

SEMESTER III AND IV ORGANIC CHEMISTRY

PRACTICALS- I

CH4BP02B18: QUALITATIVE ORGANIC ANALYSIS (micro)

Credit-2
Total Hours: 72

Aim of the course: Identification of functional groups present in organic compounds
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 was also determined.

Syllabus

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)

References

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

SEMESTER V

CH5BO5B18: ENVIRONMENTAL STUDIES AND HUMAN RIGHTS

Credits – 4
Total Lecture Hours: 72

Aim of the course: The aim of the course is to enable students to study the concept and techniques in environmental pollution and solving environmental issues and to inculcate social awareness and Human Rights. It also helps the students to have better awareness about the multidisciplinary nature of environmental studies.

Course Overview and Context: The Course is intended to discuss in details about the Ecosystem, Natural resources like forest resources, mineral resources, energy resources, land resources, Air pollution, Water pollution, Soil Pollution, waste management and toxicological effects of chemicals. It also helps us to understand the social issues and Human Rights.

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, green house 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.

Competencies of the course

- Importance of natural resources, food resources, forest resources and energy resources were discussed.
- Concept of ecosystem and different types were discussed in detail
- Impacts of Air, water, and soil pollution was summarized

- Various solid waste management procedure were compared
- Limitations of methods for management for hazardous and toxic wastes was highlighted
- Facts about air pollution, its cause, effect and control measures was ascertained
- The concept of Human rights was introduced
- Different pollution case studies were discussed
- Water quality parameters and standards were listed out
- Role of individual in the prevention of pollution was ascertained.
- Green chemistry was introduced.
- Created awareness on the effect of toxic chemicals on environment.

References

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- Dc A.K.Enviornmental Chemistry, Wiley Eastern Ltd.(Ref)
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- Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
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- Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref

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- H.J. Arnikar, Essentials of Nuclear Chemistry, 4th Edition, New Age International (P) Ltd., New Delhi, 1995 (Reprint 2005).
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BSc V Semester - Core

CODE: CH5BO5B18

COURSE TITLE: ENVIRONMENTAL STUDIES AND HUMAN RIGHTS

Modules	**Hours**	**PART A- (short answer) 2 marks 10/12**	**PART B- (short essay) 5 marks 6/9**	**PART C- (essay/problem) 15 marks 2/4**	**Total**
I	20	3	3	1	36
II	20	3	3	2	36
III	24	4	2	2	48
IV	8	2	1	0	9

B Sc PROGRAMME-CHEMISTRY CORE COURSE
CH5BO5B18: ENVIRONMENTAL STUDIES AND HUMAN RIGHTS
MODEL QUESTION PAPER
V Semester CBCS Examination

Time : 3 Hrs **Total Marks : 80**

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

1. Explain with examples producers, consumers and decomposers.
2. List the advantages and disadvantages of solar energy?
3. What do you mean by soil erosion and desertification?
4. What is Air protection Act?
5. How does the constitution of India guarantee the protection of the environment?
6. What is Rain water harvesting?
7. What is green house effect?. Name the gases responsible for green house effect.
8. Discuss the control measures of soil pollution
9. What are the consequences of ozone layer depletion?
10. Define renewable and non-renewable energy sources. Give examples
11. How do toxic chemicals act on enzymes?
12. What are the biochemical effects of CO on humans?

(10 x 2=20 marks)

PART B
(Answer any 6 questions. Each question carries 5 marks)

13. Write on Wildlife protection act and forest conservation act.
14. What is human rights? Explain the concept and developments.
15. Explain how forest resources are exploited.
16. Briefly describe the benefits and problems caused by dams.
17. Explain the energy flow in an ecosystem. What is an energy cycle?
18. What is noise pollution? How can it be controlled?
19. Explain the role of NGO/individual in the protection of environment.
20. Briefly explain the Environment Protection Act of 1986.
21. Discuss the biochemical effects of a) cadmium b) mercury

(6x 5 = 30 marks)

PART C
(Answer any 2 questions. Each question carries 15 marks)

22. a) .Explain the harmful effects of over exploitation of water resources
    b) Explain a forest ecosystem focusing on the different types, its importance and characteristics.
23. a) What is Resettlement and Rehabilitation? Discuss the reasons and problems related to Resettlement and Rehabilitation policies in India.
    b) Explain the difficulties faced by women and children in developing economies?
24. Write explanatory notes on a) acid rain b) nuclear pollution c) BOD & COD
25. Write an essay on the causes, effects and control measures employed for solid waste management.

(2 x 15 = 30 marks)

CH5BO6B18: ORGANIC CHEMISTRY - III

(Reaction mechanisms expected only wherever mentioned)

Credits – 3
Total Lecture Hours: 54

Aim of the course: To give the students a thorough knowledge about the nitrogen containing organic compounds and also to give an outline of organic spectroscopy and the applications of organic chemistry in various spheres of chemical sciences like dyes, drugs and polymers

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

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, Reductive amination 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 and ethyl 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 absorption positions 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 and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, 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-based Ziegler-Natta polymerisationof alkenes. Preparation and applications of plastics–thermosetting (Phenol-formaldehyde, Urea-formaldehyde) and thermosoftening (Polythene) Fibres (Polyamide, Polyester). Synthetic rubbers – SBR and Neoprene. Introduction to conducting polymers with examples. Environmental hazards and biodegradability of polymers. Recycling of plastics.

Competencies

- Enabled the students to understand the chemistry of nitrogen containing compounds like nitro compounds, amines and diazo compounds
- Learned in detail the chemistry of heterocyclic compounds.
- Understood the distinction between primary, secondary and tertiary amines
- Fundamentals of active methylene compounds were discussed.
- To have an elementary idea of organic spectroscopy
- To study about the role of drugs and their composition.
- Importance and different types of polymers were discussed
- Theory, classification and applications of dyes were noted.
- Types of polymers were discussed.
- Application of UV, IR and NMR spectroscopy in the structural elucidation of molecules were studied

References

- Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. *Organic Chemistry*, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry,* Wiley, 2014.
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- Jain, M.K. & Sharma, S.C. *Modern Organic Chemistry*, Vishal Publishing Co. 2010.
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- John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds,* Prentice Hall.

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BSc V Semester - Core

CODE: CH5BO6B18

COURSE TITLE: ORGANIC CHEMISTRY – III

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	23	4	3	2	39
II	5	1	1	0	6
III	11	3	2	1	23
IV	15	4	3	1	29

CH5BO7B18: PHYSICAL CHEMISTRY - I

Credits – 2
Total Lecture Hours: 36

Aim of the course: To understand the general characteristics of different states of matter

Course Overview and Context: The course is intended to impart knowledge about the different states of matter, the behaviour 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.

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 ofdeviation. 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 calculationfrom 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. Temperaturedependence of these distributions. Most probable, average and rootmean 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 1I: 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. Laws of Crystallography – Law of constancy ofinterfacial angles, Law of rational indices. Miller indices. X–Ray diffraction bycrystals, 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.

Structure of ionic compounds of thetype AX (NaCl, CsCl, ZnS) and AX2 (CaF2, Na2O) Defects in crystals – stoichiometric and non-stoichiometric defects, extrinsic and intrinsic defects. Electrical conductivity, semiconductors, n-type, p-type, Superconductivity – An introduction.

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

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

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: Types of solutions – true, colloid and suspensions, 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).

Competencies of the course

- Structure of solids were discussed
- Has been able to understand defects in crystals
- Comprehensive study of gaseous and liquid states and the intermolecular forces in liquids and gases were discussed.
- The dynamics of molecules of liquids and gases were evaluated
- Conditions for colloidal state was recognized
- To built up an awareness about the theoretical approach to adsorption and surface area.
- Defects of solids which have a profound impact on their mechanical properties was studied.
- Understand the collision properties.
- Adsorption and various types of adsorption were discussed.
- The BET theory– use of BET equation for the determination of surface area.
- Seven crystal systems and fourteen Bravais lattices were discussed
- Van der Waals equation of state – derivation and application in explaining real gas behaviour.
- Liquefaction of gases (based on Joule-Thomson effect) was discussed.

References

- R P W Atkins, *"Physical Chemistry"*, Oxford University Press
- R J Silby and R A Alberty, *"Physical Chemistry"*, John Wiley & Sons
- F Daniels and A Alberty, *"Physical Chemistry"*, Wiley Eastern
- Puri, Sharma and Pathania, *"Principles of Physical Chemistry"*, Millennium Edition, Vishal Publishing Co
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- K. L. Kapoor, "*A Textbook of Physical chemistry"*, Volume 1, Macmillan India Ltd.,
- B. R. Puri, L. R. Sharma, M. S. Pathania, "*Elements of Physical chemistry"*, Vishal Pub. Co.,
- L V Azaroff, *"Introduction to Solids"*, McGraw Hill.
- N B Hannay, *"Solid State Chemistry"*, Prentice Hall.
- A. McQuarrie, J. D. Simon, *"Physical Chemistry – A molecular Approach"*, Viva Books Pvt. Ltd.
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BSc V Semester - Core

CODE: CH5BO7B18

COURSE TITLE: PHYSICAL CHEMISTRY – I

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	12	4	2	2	34
II	18	5	4	2	45
III	6	3	3	0	18

CH5BO8B18: PHYSICAL CHEMISTRY – II

Credits - 3

Total Lecture Hours: 36

Aim of the course: To understand the fundamentals of quantum mechanics and its applications in the study of structure of atoms, to understand the basics and to introduce the concepts of molecular spectroscopy

Course Overview and Context: Introduction to quantum mechanics and its applications, spectroscopic techniques - rotational, vibrational, electronic and NMR, concepts in molecular symmetry.

Module I: Quantum Mechanics - I **(6 Hrs)**

Classical mechanics: Concepts, Radiation phenomena –Blackbody radiation, Photoelectric effect, Compton effect and Atomic spectra. Plank's quantum theory and explanation of the radiation phenomena.de Broglie hypothesis, dual nature of electrons – Davisson and Germer's experiment. Heisensberg's 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 energy levels, Selection rules.

Vibrational spectroscopy: Introduction, Selection Rules, Classical equation of vibration, 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 of simple radical - methyl radical.

Competencies of the course

- Concepts in classical mechanics are discussed.
- Postulates of quantum mechanics and the quantum mechanical model of the hydrogen
- atom were studied
- Discussion on the difference between classical and quantum mechanics
- Treatment of particle in a one dimensional box based on Quantum mechanics
- Development of Valence bond and molecular orbital theory from quantum mechanics was introduced.

- Detailed study on the applications of microwave, infra red, Raman and electronic spectroscopy.
- Molecular orbital theory: basic ideas were studied
- Introduction to the concepts of molecular symmetry.
- Complementary nature of IR and Raman Spectra was discussed
- Selection rules were studied.
- Concept of group frequencies – frequencies of common functional groups in organic compounds was introduced
- Crystallographic point groups and its importance were studied.
- Introduced the basic concepts in NMR with focus on chemical shift, shielding and deshielding and spin-spin splitting.

References

- R.K. Prasad, *Quantum Chemistry*, New Age International, 2001
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- N. J. Turro, *Modern Molecular Photochemistry*, 4th Edition University Science Books,Sausalito, 1991.
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BSc V Semester - Core

CODE: CH5BO8B18

COURSE TITLE: PHYSICAL CHEMISTRY – II

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	6	2	2	0	12
II	8	3	2	1	23
III	12	4	3	2	39
IV	10	3	2	1	23

OPEN COURSE

CH5D01aB18: CHEMISTRY IN EVERYDAY LIFE

(Chemical structures are non-evaluative)

Credits – 3
Total Lecture Hours : 72

Aim of the course: The aim of the course is to promote understanding of the basic facts of nanomaterials and organic chemistry compounds used in everyday life.

Course Overview and Context: This unit deals with food additives, chemicals used in agriculture, soaps, detergents, cosmetics, plastics, paper, dyes, drugs and nanomaterials used in everyday life.

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 and Drugs (18 Hrs)

Plastics: Plastics in everyday life. Plastics and Polymers. Classification of polymers. Brief idea of polymerization. Use of LDPE, HDPE, PP, PVC and PS. Environmental hazards of plastics. Biodegradable plastics. Recycling of plastics.

Paper: Introduction. Paper manufacture (basic idea only). Weight and size of paper. Types of paper - News print paper, writing paper, paperboards, cardboards. Environmental impact of paper. International recycling codes, and symbols for identification of plastics.

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

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

Module IV : Nanomaterials (12 Hrs)

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

Competencies of the course

- Understand various elementary aspects of food additives
- Analyze the importance of fertilizers in agricultural chemistry
- Understand the preparation and application of nanomaterials
- Understand the fundamentals different types of soaps, detergants and cosmetics
- Role of plastic, paper, dyes and drugs were discussed.

References

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- B.K. Sharma; *Industrial Chemistry*. Goel Publishing House, Meerut, 2003.
- C.N.R. Rao; *Understanding Chemistry*, Universities Press.
- M.K. Jain and S.C. Sharma; *Modern Organic Chemistry*, Vishal Pub. Co., Jalandhar, 2009.
- A.K. De; *Environmental Chemistry*, New Age International Ltd., New Delhi, 2006.
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- D. Sriram and P. Yogeeswari; *Medicinal Chemistry*, 2nd edn. Pearson, 2011.
- S.L. Tisdale; W.L.Nelson and J.D.Beaton; *Soil Fertility and Fertilizers,* Macmillan Publishing Company, New York, 1990.
- K.H.Buchel; *Chemistry of Pesticides*, John Wiley & Sons, New York, 1983.
- P.C. Pall; K. Goel and R.K. Gupta*; Insecticides, Pesticides and Argobased Industries.*
- T. Pradeep; *Nano- The Essentials*, McGraw Hill Publishing Co., New Delhi, 2007.
- V.S.Muraleedharan, A. Subramania*; Nanoscience and Nanotechnology*, Ane Books, New Delhi, 2009.
- K.J. Klabunde; *Nanoscale Materials in Chemistry*, Wiley.
- Singh, K., *Chemistry in Daily Life;* Prentice Hall of India, New Delhi, 2008.

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BSc V Semester - OPEN COURSE

CODE: CH5D01aB18

COURSE TITLE: CHEMISTRY IN EVERYDAY LIFE

Modules	Hours	PART A- (short answer) 2 marks 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 15 marks 2/4	Total
I	24	3	5	1	46
II	18	3	2	1	31
III	18	3	0	2	36
IV	12	3	2	0	16

CH5D01bB18: NANOSCIENCE AND NANOTECHNOLOGY

Credits – 3
Total Lecture Hours: 72

Module I : Hitory 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 (18 Hrs)

Fundamental particles-elctromagnetic radiation- its components- impact on matter-the Planck's equation- de Broglie relation- matter-wave concept of radiation- concept of colour and vision-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

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- R. Booker and , E. Boysen, Nanotechnology, Wiley India Pvt Ltd, 2008.

CH5D01cB18: FORENSIC SCIENCE

Credits – 3
Total Lecture Hours:72

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

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

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

SEMESTER VI

CH6B09B18: INORGANIC CHEMISTRY

Credits - 3
Total Lecture Hours: 54

Aim of the course: To study about coordination compounds, Boron, Inter-halogen and Noble Gas Compounds , organometallic compounds and bio-inorganic chemistry.

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.

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.

Competencies of the course

- To understand about coordination chemistry
- Has been able to understand the role of complexes in biological systems
- Application of chelates
- Application of coordination compounds in qualitative and quantitative analysis
- Discussed in details about crystal field theory
- Organometallic chemistry was studied from an industrial point of view
- Bonding in organometallics was introduced
- Role of organometallic in synthetic organic chemistry was studied

- To understand the role of essential and trace elements in biological systems
- Focus on toxic metal ions and their effects
- Ascertain the role of chelation therapy in toxicity studies
- Ascertain Importance of Na+-ion pump
- Discussed about interhalogen and noble gas compounds.

References

- F.A. Cotton and G. Wilkinson, *Advanced Inorganic Chemistry*, 6th Edition, Wiley India Pvt. Ltd., New Delhi, 2009 (Reprint).
- J.E. Huheey, E.A. Keitler and R.L. Keitler, *Inorganic Chemistry–Principles ofStructure and Reactivity,* 4th Edition, Pearson Education, New Delhi, 2013.
- D.F. Shriver and P. Atkins, *Inorganic Chemistry*, 5th Edition, Oxford University Press, New York, 2010.
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BSc VI Semester - Core

CODE: CH6B09B18

COURSE TITLE: INORGANIC CHEMISTRY

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	27	4	4	2	44
II	12	3	2	1	23
III	6	3	2	0	13
IV	9	2	1	1	17

SEMESTER VI

CH6B10B18: ORGANIC CHEMISTRY - IV

Credits - 3
Total Lecture Hours: 54

Aim of the course: To give an outline of chemistry of natural products, supramolecular chemistr, organic photochemistry and nuclic acids

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.

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 of cholesterol. Elementary idea of HDL and LDL.

Hormones: Introduction. Examples and biological functions of steroid hormones, peptide hormones 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 Aicds, 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 (upto tripeptides) by N-protecting (benzyloxycarbonyl and *t*-butyloxycarbonyl) & 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 II

reactions of acyclic ketones, Paterno-Buchi reaction and Photo-Fries reaction (with mechanisms).

Competencies of the course

- Enabled the students to understand the chemistry of carbohydrates
- Learned the fundamentals of supramolecular chemistry.
- Understood the structure and functions of amino acids, proteins, enzymes, and nucleic acids.
- Fundamentals of terpenoids and alkaloids were discussed.
- To have an elementary idea of Green Fluorescent Proteins
- To study about the role of vitamins and lipids.
- Importance of steroids and hormones in the biological system were discussed
- Role of nucleic acid in protein synthesis was noted.
- Types of nucleic acids were discussed.
- Structure of nucleic acids were studied
- The fundamentals of organic photochemistry was discussed

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BSc VI Semester - Core

CODE: CH6B10B18

COURSE TITLE: - ORGANIC CHEMISTRY – IV

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	18	4	2	2	34
II	23	4	3	2	39
III	6	2	2	0	12
IV	7	2	2	0	12

CH6B11B18: PHYSICAL CHEMISTRY – III

Credits – 3
Total Lecture Hours: 54

Aim of the course: To provide an insight into the thermodynamics , equilibria and chemical kinetics

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

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 IInd 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'tHoffs 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 ofbuffer 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.Iintegrated rateexpressions 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.

Competencies of the course

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

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BSc VI Semester - Core

CODE: CH6B11B18

COURSE TITLE: - PHYSICAL CHEMISTRY – III

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	27	4	4	2	44
II	11	3	1	1	18
III	6	3	2	0	13
IV	10	2	2	1	22

CH6B12B18: PHYSICAL CHEMISTRY – IV

Credits – 3
Total Lecture Hours: 54

Aim of the course: To provide an insight into various physical chemistry concepts like solutions, electrochemical phenomena, group theory and photochemistry.

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.

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.

Competencies

- To study the various aspects of binary liquid mixtures, CST and Colligative properties
- To study osmotic pressure and its applications
- To study the basics, concepts, methods and applications of conductance measurements
- To study the various aspects of the cell its construction and working , thermodynamics and applications of emf measurements.
- To create basic awareness about photochemical and photo physical process.
- To understand Deby Huckel theory of strong electrolyte
- To differentiate conductometric and potentiometric titrations
- To study electrochemical theory behind corrosion
- To understand the laws of photochemistry
- To get an elementary idea about group theory

References

- B. R. Puri, L. R. Sharma, M. S. Pathania, *Elements of Physical chemistry*, VishalPub. Co. Jalandhar.
- K. L. Kapoor, *A Textbook of Physical chemistry*, *Volume 4*, Macmillan India Ltd.
- Barrow, G.M. *Physical Chemistry*,Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry*,4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R., *General Chemistry*, Cengage Learning India Pvt. Ltd. New Delhi (2009).
- Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).
- K. L. Kapoor, *A Textbook of Physical chemistry*, *Volumes 1*, Macmillan India Ltd,
- Glasstone S, *An Introduction to Electrochemistry*, East-West Press (Pvt.) Ltd. (2006).
- Gurdeep Raj, *Advanced Physical Chemistry*, Goel publishing house.
- Glasstone and Lewis, *Elements of Physical Chemistry*, Macmillan
- K. L. Kapoor, *A Textbook of Physical chemistry*, *Volumes 3*, Macmillan IndiaLtd.
- I.N. Levine, *Physical Chemistry*, Tata McGraw Hill
- F A Alberty and R J Silby, *Physical Chemistry*, John Wiley.
- P. W. Atkins,*The elements of Physical chemistry*, 8thedn, Oxford UniversityPress.
- D. A. McQuarrie, J. D. Simon, *Physical Chemistry – A molecular Approach*, Viva Books Pvt.Ltd.
- S. H. Marron and J. B. Lando, *Fundamentals of Physical Chemistry*, MacmillanLtd.
- G. K. Vemulapalli, *Physical Chemistry*, Prentice-Hall of India Pvt. Ltd. (1997) V Ramakrishnan and M S Gopinathan, *"Group Theory in Chemistry"*, Vishal Publishing.

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BSc VI Semester - Core

CODE: CH6B12B18

COURSE TITLE: - PHYSICAL CHEMISTRY – IV

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	24	4	5	2	49
II	15	3	3	2	38
III	6	2	2	0	12
IV	9	3	2	0	13

PRACTICALS
SEMESTER V & VI

CH6BP03B18: QUALITATIVE INORGANIC MICRO ANALYSIS

Credits – 2
Total Hours : 108

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)

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

CH6BP04B18: ORGANIC PREPARATIONS AND LABORATORY TECHNIQUES

Credits-2
Total Hours: 72

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

References

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

CH6BP05B18: PHYSICAL CHEMISTRY PRACTICALS

Credits - 2
Total Lecture Hours: 108

1. Viscosity – percentage composition of a mixture.
2. Heat of solution – KNO_3, NH_4Cl
3. Heat of neutralization
4. Determination of equivalent conductance of an electrolyte
5. Conductometric titration – strong acid *vs.* strong base, weak acid-strong base
6. 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. (using naphthalene,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 – Fe^{2+} *vs.* $Cr_2O_7^{2-}$, I^- *vs.* MnO^{4-}
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.

References

- W. G. Palmer: 'Experimental physical chemistry', Cambridge University Press.
- J.B. Yadav: Advanced Practical Physical Chemistry Goel Publishing House.
- R.C. Das and B. Behra; 'Experiments in Physical Chemistry' , Tata McGraw hill.
- K.K. Sharma : 'An Introduction of Practical Chemistry': Vikas Publishing House, New Delhi
- Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry,*R. Chand & Co.: New Delhi (2011).

CH6BP06B18: GRAVIMETRIC ANALYSIS

Credits – 2
Total Lecture Hours: 36 **Semester VI only**

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.

References

- J. Mendham. R.C. Denney, J.D. Barnes and M. Thomas, *Vogel's Textbook of Quantitative Chemical Analysis*, 6th Edition, Pearson Education, Noida, 2013.
- 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.
- G. D. Christian, Analytical Chemistry, JohnWiley and Sons.
- R. D. Day, A. L. Uderwood, Quantitative analysis,

Semester VI

CHOICE BASED COURSES

CH6B13aB18: NANOCHEMISTRY AND NANOTECHNOLOGY

Credits – 3
Total Lecture Hours: 54

Aim of the course: To provide an insight into the latest development in nanochemistry and nanotechnology.

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.

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.

Competencies of the course

- Understand various elementary aspects of nanomaterials
- Analyse electrical and optical properties of nanomaterials
- Understand the preparation and application of nanomaterials
- Understand the characterization of nanomaterials like SEM, TEM, STEM etc

References

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

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BSc VI Semester - CHOICE BASED COURSES

CODE: CH6B13aB18

COURSE TITLE: - NANOCHEMISTRY AND NANOTECHNOLOGY

Modules	Hours	PART A- (short answer) 2 marks 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 15 marks 2/4	Total
I	18	4	3	1	38
II	18	3	2	2	46
III	6	3	2	0	16
IV	12	2	2	1	29

CH6B13bB18: POLYMER CHEMISTRY

Credits – 3
Total Lecture Hours: 54

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 of crystallinity, 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 transition temperature (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-phenylene sulphide), polypyrrole, polythiophene. Conduction mechanism and applications. Carbon nanotubes. Synthesis and applications (elementary idea only).

References

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

CH6B13cB18: SOIL AND AGRICULTURAL CHEMISTRY

Credits – 3
Total Lecture Hours: 54

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

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

SYLLABUS FOR B.Sc. CHEMISTRY (COMPLEMENTARY)

SEMESTER I

CH1C01B18: BASIC THEORETICAL AND ANALYTICAL CHEMISTRY

[Common for students who have opted Botany, Zoology, Family & Community Science (Home science)]

Credits – 2
Total Lecture Hours: 36

Aim of the course: To provide awareness about the basic concepts and principles of theoretical and quantitative practical chemistry

Course Overview and Context: Atomic structure, acids and bases, theory of indicators, principles of precipitation, analytical techniques, titrimetry, separation and purification techniques are dealt in this course. Different chromatographic techniques are also dealt with.

Module 1 : 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 favouring the formation 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 in properties: 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 and secondary 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.

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).

Competencies of the course

- Discussion on atomic structure,
- Usefulness of titrimetry in analytical procedures
- To understand the theory of precipitation
- Chromatographic Procedures were discussed
- Preparation of solutions of different concentration.
- To understand the theory of indicators
- To understand the concept of equilibrium
- Periodic table and periodic properties were discussed
- To study different types of hybridization

References

- B. R. Puri, L. R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 3rd edn. Vishal Pub. Co., 2008.
- C. N. R. Rao, *University General Chemistry*, Macmillan, 2009.
- Manas Chanda, *Atomic Structure and Molecular Spectroscopy.*
- P. L. Soni, *Inorganic Chemistry* .
- R. A. Day Junior, A.L. Underwood, *Quantitative Analysis*, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988.

- J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th edn. Pearson Education (2003).
- R. Gopalan, *Analytical Chemistry*, S. Chand and Co., New Delhi.

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B.Sc. I Semester - COMPLEMENTARY
CODE: CH1C01B18

COURSE TITLE: - BASIC THEORETICAL AND ANALYTICAL CHEMISTRY

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	12	3	2	2	33
II	9	3	2	1	23
III	9	3	2	1	23
IV	6	3	3	0	18

B Sc PROGRAMME-CHEMISTRY COMPLEMENTARY COURSE

CH1C01B18: BASIC THEORETICAL AND ANALYTICAL CHEMISTRY
[Common for students who have opted Botany, Zoology, Family & Community Science (Home science)]

MODEL QUESTION PAPER
First Semester CBCS Examination

Time : 3 Hrs **Total Marks : 60**

PART A
(Answer any 10 questions. Each question carries 1 mark)

1. Define and explain Hund's rule of maximum multiplicity.
2. Derive de Broglie equation and explain the terms.
3. Define and explain Aufbau principle.
4. What is meant by ionization enthalpy?
5. Define ionic product of water.
6. What are Ka, Kb, pKa and pKb?
7. What are significant figures? Explain with examples.
8. What are the differences between precision and accuracy?
9. What are primary and secondary standards? Give examples.
10. Define Rf value. What is its significance?
11. Name the important adsorbents used in column chromatography.
12. Briefly discuss the classification of chromatographic methods.

(10 x 1=10 marks)

PART B
(Answer any 6 questions. Each question carries 5 marks)

13. Write a brief note on Dual nature of matter and radiation.
14. State and explain Heisenberg's uncertainty principle.
15. Discuss the basic principle and uses of HPLC
16. Explain how will you separate a mixture of coloured pigments using column chromatography.
17. Write a note on periodicity in properties such as: Atomic radii, ionic radii, electron affinity, and electro negativity.
18. Explain common ion effect and its applications.
19. Write a note on the preparation of standard solution. Illustrate with an example.
20. Explain the principle of fractional distillation. Illustrate with an example.
21. Write a note on the principle and instrumentation of ion-exchange chromatography.

(6x 5 = 30 marks)

PART C

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

22. Discuss various types of bonding and briefly explain the theories of chemical bonding with special reference to covalent bonding.
23. Write an essay on the quantum numbers and shapes of atomic orbitals.
24. Discuss the concept of chemical equilibrium. Explain Arrhenius, Lowry-Bronsted and Lewis theories.
25. Write an essay on the principles of volumetric analysis with special mention of acid-base and redox titrations.

(2 x 10 = 20 marks)

SEMESTER II
CH2C01B18: BASIC ORGANIC CHEMISTRY

[Common for students who have opted Botany, Zoology, Family & Community Science (Home science)]

Credits – 2
Total Lecture Hours: 36

Aim of the course: To promote understanding of basic facts and concepts and to inculcate interest in Organic Chemistry

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.

Module 1: 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: Inductive effect - Definition - Examples - +I and -I groups. Applications: Explanation of substituent 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 and but-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.

Competencies of the course

- To get an overview of IUPAC nomenclature
- Classification and synthesis of various types of polymers were discussed
- Stereochemistry of organic compounds was discussed in detail
- To Understand the environmental hazards and biodegradability of polymers
- Organic reaction mechanisms were discussed.

References

- I. L. Finar, Organic Chemistry Vol. I , 6th edn. Pearson.
- M.K. Jain, S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co. 2010.
- S. M. Mukherji, S. P Singh, R. P Kapoor, Organic Chemistry Vol.1, New Age International Pvt. Ltd, 2006.
- S. Sengupta, *Basic Stereochemisty of Organic Molecules,* 2014.
- E. L. Eliel, S.H. Wilen, *Sterechemistry of Organic Compounds,* Wiley, 1994.
- Peter Sykes, *A Guide Book to Mechanism in Organic Chemistry*, 6th edn. Orient Longman, 1988.
- S. M. Mukherji, S.P Singh*, Reaction Mechanism in Organic Chemistry*, Macmillan, 3rd edn., 2003.

- V.R. Gowarikar, N.V. Viswanathan, J. Sreedhar, *Polymer Science*, 2nd edn., New Age International Pvt. Ltd., 2015.

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BSc II Semester - COMPLEMENTARY

CODE: CH2C01B18

COURSE TITLE: - BASIC ORGANIC CHEMISTRY

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	9	3	2	1	23
II	9	3	3	1	28
III	9	3	2	1	23
IV	9	3	2	1	23

SEMESTER III

CH3C01B18: INORGANIC AND ORGANIC CHEMISTRY

[Common for students who have opted Botany, Zoology, Family & Community Science (Home science)]

Credits – 3
Total Lecture Hours: 54

Aim of the course: To promote understanding facts and concepts in inorganic and organic chemistry.

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

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 Chemistry and 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 – stomach poisons, 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).

Competencies of the course

- The basic concept of drugs and their classification was studied
- To investigate various types of food additives and food adultration
- Nuclear chemistry and its application was dealt with.
- Role of pesticides and insecticides in agriculture was discussed
- Differentiate between nuclear fission and nuclear fusion

References

- H.J. Arnikar, *Essentials of Nuclear Chemistry* (Revised IV edn.),New Age, 1995.
- B. R. Puri, L. R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 3rd edn. Vishal Pub. Co., 2008.
- I. L. Finar, *Organic Chemistry* Vol. 1 & 2, 6th edn., Pearson, 2002.
- C.N. R. Rao, *University General Chemistry*, Macmillan 2009.
- B. R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers New Delhi. 2013.
- G. R. Chatwal, *Synthetic Drugs*, Himalaya Publishing House, Bombay, 1995.
- J.Ghosh, *A Textbook of Pharmaceutical Chemistry*, S. Chand & Co Ltd., 1997
- B. Sreelakshmi, *Food Science*, New Age International Pvt. Ltd, New Delhi, 2015.

- J.W. Hill, T.W. McCreary, D.K. Kolb, *Chemistry for Changing Times*, Prentice Hall, 12th edn., 2010.

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BSc III Semester - COMPLEMENTARY

CODE: CH3C01B18

COURSE TITLE: - INORGANIC AND ORGANIC CHEMISTRY

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	12	3	2	1	23
II	18	3	3	2	38
III	8	2	2	0	12
IV	8	2	0	1	12
V	8	2	2	0	12

SEMESTER IV

CH4C01B18: ADVANCED BIO-ORGANIC CHEMISTRY

[Common for students who have opted Botany, Zoology, Family & Community Science (Home science)]

Credits - 3
Total Lecture Hours: 54

Aim of the course The aim of this course is to promote understanding of facts and concepts in Advanced bio-organic chemistry and to develop interest in the study of biomolecules.

Course Overview and Context: Enzymes ,Nucleic acids & vitamins, Amino acids and proteins, Carbohydrates , Lipids Fats &Oils, steroid and hormones.

Module I : Natural Products **(12 Hrs)**

Terpenoids: Classification with examples – Isoprene rule – Isolation of essential oils by steam 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 physiological activity of nicotine, coniine and piperine.

Lipids: Classification – Oils, fats and waxes (definition, structure, biological functions and examples). 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. Synthetic detergents - 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 of glycine, 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 vitamins A, 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 and LDL. 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).

Competencies of the course

- Classification and characteristics of enzymes and mechanism of enzyme action.
- To differentiate between different types Nucleic acids, ADP, ATP and AMP
- To study the biological effects of various types of vitamins
- To outline the classification and properties of amino acids.
- To understand the structure and functions of proteins,
- To determine the classification, properties and structure of carbohydrates .
- To understand the fundamentals of oils, lipids &fats

References

- Maya Shankar Singh, L.G.Wade, *Organic Chemistry*, 6th Edition, Pearson Education, New Delhi, 2013.
- P.Y. Bruice, *Essential Organic Chemistry*, 1st Edition, Pearson Education, New Delhi, 2013.
- I.L. Finar, *Organic Chemistry Vol. I & II,* 5th Edition, Pearson Education, New Delhi, 2013.
- M.K. Jain, S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co. 2010.

- 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.
- A. Bahl and B.S. Bahl, *Advanced Organic Chemistry*, 1st Multicolour Edition, S. Chand & Company, New Delhi, 2010.
- A.C. Deb, *Fundamentals of Biochemistry*, 9th Edn. New Central Book Agency,2001.
- Rastogi, *Biochemistry*, Tata Mc Graw –Hill Publication ,1996.
- Bhat S.V., Nagasampagi, B.A. & Sivakumar M. *Chemistry of Natural Products*, Narosa, 2005.

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BSc IV Semester - COMPLEMENTARY

CODE: CH4C01B18

COURSE TITLE: - ADVANCED BIO-ORGANIC CHEMISTRY

Modules	Hours	PART A- (short answer) 1 mark 10/12	PART B- (short essay) 5 marks 6/9	PART C- (essay/problem) 10 marks 2/4	Total
I	12	3	2	1	23
II	12	3	2	1	23
III	9	1	1	1	16
IV	12	3	2	1	23
V	9	2	2	0	12

PRACTICAL

(Semester I and II)
[Common for students who have opted Botany, Zoology, Family & Community Science (Home science)]

CH2CP01B18: VOLUMETRIC ANALYSIS

Credits – 2
Total Hours: 72

Standard solution must be prepared by the student.

1. Acidimetry and Alkalimetry

1. Standardization of HCl with standard Na_2CO_3 solution
2. Standardization of NaOH with standard oxalic acid solution
3. Estimation of any acid using standard NaOH
4. Estimation of any alkali using standard HCl.

2. Permanganometry

1. Standardization of $KMnO_4$ using (i) oxalic acid (ii) Mohr's salt
2. Estimation of Fe^{2+} in Mohr's salt and crystalline Ferrous Sulphate using standard $KMnO_4$.

3. Dichrometry

1. Estimation of Ferrous ions (external indicator)
2. Estimation of Ferrous ions (internal indicator)
3. Estimation of $FeSO_4$. 7 H_2O (external indicator)

4. Iodimetry and Iodometry

1. Standardization of Iodine solution
2. Standardization of Sodium thiosulphate
3. Estimation of $KMnO_4$
4. Estimation of Copper

References

- D. A. Skoog, D. M. West, and S. R. Crouch, *Fundamentals of Analytical Chemistry* 8th edn, Brooks/Cole Nelson
- *Vogel's Textbook of Quantitative Chemical Analysis* 6th edn., Pearson Education. Ltd.
- G. D. Christian, *Analytical Chemistry*, JohnWiley and Sons
- R.D Day, A.L. Underwood, *Quantitative Analysis*, 6th Edn., Prentice Hall of India Pvt. Ltd.

CH4CP01B18: ORGANIC CHEMISTRY PRACTICALS

[Common for students who have opted Botany, Zoology, Family & Community Science (Home science)]

Credit – 2

Total Hours: 72 Hrs

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)

References

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