KANNUR UNIVERSITY

(Abstract)

B Sc Chemistry/ B.Sc.Biochemistry/B.Sc.Polymer Chemistry Programmes -Scheme, Syllabus and Pattern of Question Papers of Core, Complementary Elective and Generic Elective Course under Choice Based Credit and Semester System (Outcome Based Education System-OBE) in Affiliated colleges with effect from 2019 Admission-Implemented-Orders issued.

Academic Branch

No.Acad/C2/12380/2019/II Civil Station P.O Dated 20/06/2019

Read:- 1. U.O.No.Acad.C2/429/2017 dt.10-10-2017

2. The Minutes of the Meeting of the Curriculum Restructuring Committee held on 28-12-2018.
3. U.O No.Acad.C2/429/2017 Vol.II dt.03-06-2019
4. The Minutes of the meeting of the Board of Studies in ChemistryUG held on 07-06-2019
5. The Syllabus submitted by the Chairperson, Board of Studies in Chemistry (UG)dated 13/06/2019

ORDER

1. A Curriculum Restructuring Committee was constituted in the University vide the paper read (1) above to co-ordinate the activities of the Syllabus Revision of UG programmes in Affiliated colleges of the University.

2. The meeting of the Members of the Curriculum Restructuring Committee and the Chairpersons of different Boards of Studies held, vide the paper read (2) above, proposed the different phases of Syllabus Revision processes such as conducting the meeting of various Boards of Studies, Workshops and discussions.

3. The Revised Regulation for UG programmes in Affiliated colleges under Choice Based Credit and Semester System (in OBE-Outcome Based Education System) was implemented with effect from 2019 Admission as per paper read (3) above.

4. Subsequently, as per paper read (4) above, the Board of Studies in Chemistry (UG) finalized the Scheme, Syllabus & Pattern of Question Paper for Core, Complementary Elective & Generic Elective Course of B.Sc.Chemistry/B.Sc. Biochemistry/ B.Sc.Polymer Chemistry Programmes to be implemented with effect from 2019 Admission.

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5. As per paper read (5) above, the Chairperson, Board of Studies in Chemistry (UG) has submitted the finalized copy of the Scheme, Syllabus & Pattern of Question Papers of B.Sc. Chemistry/ B.Sc Biochemistry/ B.Sc Polymer Chemistry programmes.
6. The Vice Chancellor after considering the matter in detail and in exercise of the powers of the Academic Council conferred under Section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with accorded sanction to implement the Scheme, Syllabus & Pattern of Question Paper(Core/Complementary Elective/Generic Elective Course) of B.Sc Chemistry, B.Sc Biochemistry and B.Sc Polymer Chemistry programme under Choice Based Credit and Semester System(in OBE-Outcome Based Education System) in Affiliated colleges with effect from 2019 Admission, subject to reporting to the Academic Council.

7. The Scheme, Syllabus & Pattern of Question Papers of B.Sc Chemistry/ B.Sc Biochemistry/ B.Sc Polymer Chemistry Programmes are uploaded in the University website (www.kannuruniversity.ac.in)

Orders are issued accordingly.

Sd/-
DEPUTY REGISTRAR(ACADEMIC)
for REGISTRAR

To

The Principals of Colleges offering B.Sc Chemistry/ B.Sc Biochemistry/ B.Sc Polymer Chemistry programme

Copy to:-

1. The Examination Branch (through PA to CE)
2. The Chairperson, Board of Studies in Chemistry (UG)
3. PS to VC/PA to PVC/PA to Registrar
4. DR/AR-I, Academic
5. The Computer Programmer(for uploading in the website)
6. SF/DF/FC

KANNUR UNIVERSITY * CIVIL STATION P.O. KANNUR Pin-670 002 * THAVAKKARA *

Forwarded/By Order

SECTION OFFICER

KANNUR UNIVERSITY

BOARD OF STUDIES, CHEMISTRY (UG)

SYLLABUS FOR POLYMER CHEMISTRY CORE COURSE

COMPLEMENTARY ELECTIVE COURSE AND GENERIC ELECTIVE COURSES

FOR BSc POLYMER CHEMISTRY PROGRAMME

CHOICE BASED CREDIT AND SEMESTER SYSTEM

(2019 ADMISSION ONWARDS)

ANNEXURE (i)

KANNUR UNIVERSITY

VISION AND MISSION STATEMENTS

Vision: To establish a teaching, residential and affiliating University and to provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge with special focus on the development of higher education in Kasargode and Kannur Revenue Districts and the Manandavady Taluk of Wayanad Revenue District.

Mission:

- To produce and disseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive values as the foundational principles of higher educationand to cater to the modern notions of equity, social justice and merit in all educational endeavors.
- To affiliate colleges and other institutions of higher learning and to monitor academic, ethical, administrative and infrastructural standards in such institutions.
- To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as non-governmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

ANNEXURE (ii)

KANNUR UNIVERSITY

PROGRAMME OUTCOMES (PO)

PO 1.Critical Thinking:

1.1. Acquire the ability to apply the basic tenets of logic and science to thoughts, actions and interventions.

1.2. Develop the ability to chart out a progressive direction for actions and interventions by learning to recognize the presence of hegemonic ideology within certain dominant notions.

1.3 Develop self-critical abilities and also the ability to view positions, problems and social issues from plural perspectives.

PO 2.Effective Citizenship:

2.1. Learn to participate in nation building by adhering to the principles of sovereignty of the nation, socialism, secularism, democracy and the values that guide a republic.

2.2. Develop and practice gender sensitive attitudes, environmental awareness, empathetic social awareness about various kinds of marginalisation and the ability to understand and resist various kinds of discriminations.

2.3. Internalise certain highlights of the nation's and region's history. Especially of the freedom movement, the renaissance within native societies and the project of modernisation of the post-colonial society.

PO 3.Effective Communication:

3.1. Acquire the ability to speak, write, read and listen clearly in person and through electronic media in both English and in one Modern Indian Language

3.2. Learn to articulate, analyse, synthesise, and evaluate ideas and situations in a well-informed manner.

3.3. Generate hypotheses and articulate assent or dissent by employing both reason and creative thinking.

PO 4.Interdisciplinarity:

4.1. Perceive knowledge as an organic, comprehensive, interrelated and integrated faculty of the human mind.

4.2. Understand the issues of environmental contexts and sustainable development as a basic interdisciplinary concern of all disciplines.

4.3. Develop aesthetic, social, humanistic and artistic sensibilities for problem solving and evolving a comprehensive perspective.

PREFACE

The syllabus is prepared based on an interdisciplinary approach and aim to provide the students a deep understanding of the basic concepts of chemical sciences by acquiring the knowledge of terms, facts, concepts, processes, techniques and principles of the subject. It attempts to equip the students to cater to the industrial needs and to utilise them in the utmost practical manner.

The updated syllabus is prepared based on Kannur University Regulations for Choice Based Credit and Semester System for Under-Graduate Programme 2019" (in OBE – Outcome Based Education – system) (KUCBCSSUG 2019) with a view to implement outcome based education (OBE) and curriculum from the academic year 2019 -20 onwards as proposed by higher education agencies .

An OBE curriculum means, starting with a clear picture of what is important for students to be able to do, then organizing the curriculum, instruction and assessment to make sure this learning ultimately happens. Intended learning outcomes (POs, PSOs and COs) which specify what graduates completing BSc Chemistry programme are expected to know, understand and be able to do at the end of their programme of study were discussed at various stages in three day OBE workshop conducted by KSHEC Trivandrum associated with Kannur University. These learning outcomes (POs,PSOs and COs) were further discussed along with content of the syllabus and assessment methods at the workshops conducted for faculty members and other stakeholders for restructuring curriculum by Kannur University and finalised after consulting with intellectuals, academicians, faculty members , researchers and students

The B Sc degree programme in Polymer chemistry designed for students to attain the intended learning outcomes which specified as PSOs (Programme Specific Outcome) and COs(Course Outcome) are clearly stated in the syllabus.

The mission and vision statements and PO statements of the University were given in the beginning of the syllabus and PSO statements before the scheme of the syllabus . The CO statements are given in the beginning of each of the courses. Teachers need to aware these statements as these describe the desired educational accomplishments of the degree programs.The reference materials have been recommended after a thorough study. The revised course pattern, distribution of credits, scheme of evaluation and syllabus approved by the board are given.

I express my profound gratitude to the members of the Board of Studies (UG) in Chemistry who provided me extensive personal and professional support during the work of restructuring this syllabus. With immense pleasure and gratitude I remember the untiring support rendered by the faculty members of Chemistry from various Colleges of Kannur University, academic community and all other stake holders who worked for preparing this restructured syllabus and curriculum.

Saheed VK

Chairperson

Board of Studies, Chemistry (UG)

Kannur University

Kannur University

BSc Polymer Chemistry Programme

Programme Specific Outcomes (PSOs)

After successful completion of three year degree program in Polymer Chemistry a student should be able to;

PSO 1 Understand the basic concepts, preparation methods and processing techniques of polymers and its importance in the present society.

PSO 2 Demonstrate procedural knowledge about polymers that affects different areas of life like communication, nutrition, clothing, recording history, buildings and highways etc.;

PSO 3 Employ critical thinking and the scientific method to design, carry out, record and analyze the production of polymers.

PSO 4 Use chemical techniques relevant to academia and industry, generic skills and global competencies, including knowledge and skills that enable students to undertake further studies in the field of polymer chemistry or a related field, and work in the chemical and non-chemical industry sectors.

PSO 5 Undertake hands on lab work and practical activities which develop problem solving abilities required for successful career in pharmaceuticals, chemical industry, teaching, research, environmental monitoring, product quality, consumer goods industry, food products, cosmetics industry, etc.

PSO 6 Understand safety of chemicals, transfer and measurement of chemical, preparation of solutions, and find out the green route for polymer synthesis for sustainable development.

PSO 7 Create an awareness of the impact of polymers on the environment, society, and development outside the scientific community.

COURSE STRUCTURE FOR POLYMER CHEMISTRY (UG) PROGRAMME
2019 ADMISSION

SEMESTER 1

No.	Course	Hours/week	Credit	Marks		
				CE	ESE	Total
1	English Common Course I	5	4	10	40	50
2	English Common Course II	4	3	10	40	50
3	Additional Common Course I	5	4	10	40	50
4	Core Course 1 Theoretical & Inorganic Chemistry	3	3	10	40	50
5	Complementary Elective -I (Course -1)	4	2	8	32	40
6	Complementary Elective -II (Course -1)	4	3	10	40	50
	Total	25	19	58	232	290

SEMESTER II

No.	Course	Hours /week	Credit	Marks		
				CE	ESE	Total
1	English Common Course III	5	4	10	40	50
2	English Common Course IV	4	3	10	40	50
3	Additional Common Course- II	5	4	10	40	50
4	Core Course 2 (Analytical and Inorganic chemistry–I	3	3	10	40	50
5	Complementary Elective -I (Course -2)	4	2	8	32	40
6	Complementary Elective -II (Course -2)	4	3	10	40	50
	Total	25	19	58	232	290

SEMESTER III

No.	Course	Hours/week	Credit	Marks		
				CE	ESE	Total
1	General Awareness Course I Polymer Chemistry I	3	3	8	32	40
2	General Awareness Course II Polymer Chemistry II Theory, Practicals	3 +2	3	8	32	40
3	Core Course4 (Organic Chemistry I)	3	3	10	40	50
4	Core Course 3, Practical1,Part I	2	-	-	-	-
5	Core Course 5,Practical2,Part I	2	-	-	-	-
6	Complementary Elective -I (Course -3)	3	2	8	32	40
7	Complementary Elective Practical	2	-	-	-	-
8	Complementary Elective -II (Course -3)	5	3	10	40	50
	Total	25	14	44	176	220

SEMESTER IV

No.	Course	Hours/week	Credit	Marks		
				CE	ESE	Total
1	General Awareness Course III-Polymer Chemistry III Theory, Practicals	3 + 2	3 + 4	8 +8	32 +32	40+40
2	General Awareness Course IV-Polymer Chemistry IV	**3**	3	8	32	40
3	Core Course 6 (Organic Chemistry II)	3	3	10	40	50
4	Core Course 3, Practical1, Part II	2	2	10	40	50
5	Core Course 5, Practical 2, Part II	2	2	10	40	50
6	Complementary Elective -I (Course -4)	3	2	8	32	40
7	Complementary Elective Practical	2	4	8	32	40
8	Complementary Elective -II (Course -4)	5	3	10	40	50
	Total	25	26	80	320	400

SEMESTER V

No.	Course	Hours/week	Credit	Marks		
				CE	ESE	Total
1	Generic Elective Course	2	2	5	20	25
2	Core Course 7 Analytical and Inorganic chemistry-II	3	4	10	40	50
3	Core Course 8 (Inorganic Chemistry)	3	4	10	40	50
4	Core Course 9 (Physical Chemistry-I)	3	4	10	40	50

5	Core Course 10 (Physical Chemistry-II)	3	4	10	40	50
6	Core Course 11,Practical 3	5	-	-	-	-
7	Core Course 12, Practical 4	5	-	-	-	-
8	Core Course 13 Project/Industrial Visit	1	-	-	-	-
	Total	25	18	45	180	225

SEMESTER VI

No.	Course	Hours/week	Credit	Marks		
				CE	ESE	Total
1	Core Course 14 (Organic Chemistry-III)	4	4	10	40	50
2	Core Course 15 (Physical Chemistry-III)	4	3	10	40	50
3	Core Course 16 (Physical methods In Chemistry)	3	3	10	40	50
4	Core Course 17 Discipline Specific Elective Course	3	3	10	40	50
5	Core Course 18, Practical 5	5	3	10	40	50
6	Core Course 11& 12 Practical 3& 4	5	3 +3	10 10	40 40	50 50
7	Core Course 13 Project Industrial Visit	1	2	4	5 + 16	25
	Total	25	24	74	301	375

First Complementary Elective- Physics/Computer Science,

Second Complementary Elective-Mathematics

Total Credit = 120

Total Marks = 1800

Scheme of Mark distribution – B.Sc. Polymer Chemistry Programme

Course	**No.of Papers**	**Marks per paper**	**Total Marks**
English Common Course	4	50	200
Additional Common Course	2	50	100
Common Course-General Awareness Course -Polymer Chemistry	5 (4 Theory + 1 Practical)	40	200
Complementary Elective Course - Physics/Computer Science	5 (4 Theory + 1 Practical)	40	200
Complementary Elective Course CSEC - Mathematics	4	50	200
Core Course-Chemistry	17 (12 Theory + 5 Practicals)	50	850
Project	1	25	25
Generic Elective Course	1	25	25

Credit distribution - B Sc Polymer Chemistry Programme (Semester I to VI)

Programme	Sem.	Common*		General Awareness Course	Core	Complementary Elective Course *		Generic Elective Course	Total
		Eng	Addl		Chemistry	Mathematics	Physics/ Computer Science		
BSc. (Polymer Chemistry)	I	4 + 3	4	-	3	3	2	-	19
	II	4 + 3	4	-	3	3	2	-	19
	III	-	-	3 + 3	3	3	2	-	14
	IV	-	-	3+3+4	3+2+2	3	2 +4	-	26
	V	-	-	-	4+4+4+4	-	-	2	18
	VI	-	-	-	4+3+3+3 +3+ 3+3+2	-	-	-	24
	Total	14	8	16	56	12	12	2	120

Components of Core (Chemistry)

The core courses of BSc Polymer Chemisty Programme will consists of the following components.

- Ø Theory
- Ø Practical
- Ø Project (Investigatory)
- Ø Study tour (Visiting Factory/ science institute/laboratory).

Scheme of Core course Polymer Chemistry

No.	Semester	Course code	Title of the Course	Credits	Contact hr/week
1	I	1B01PCH	Theoretical and Inorganic Chemistry	3	3
2	II	2B02PCH	Analytical and Inorganic chemistry-I	3	3
3	III	3B04 PCH/CHE	Organic Chemistry-I	3	3
4	IV	4B06 PCH/CHE	Organic Chemistry-II	3	3
5	IV	3B03 PCH/CHE & 4B03 PCH/CHE	*Core Course Practicals 1 Volumetric Analysis	2	2—III Sem 2—IV Sem
6	IV	3B05 PCH/CHE & 4B05 PCH/CHE	*Core Course Practicals 2 Inorganic Qualitative Analysis	2	2—III Sem 2—IV Sem
7	V	5B07 PCH/CHE	Analytical and Inorganic chemistry-II	4	3
8	V	5B08 PCH/CHE	Inorganic Chemistry	4	3
9	V	5B09 PCH/CHE	Physical Chemistry- I	4	3
10	V	5B10 PCH/CHE	Physical Chemistry- II	4	3
11	VI	6B14 PCH/CHE	Organic Chemistry III	4	4
12	VI	6B15 PCH/CHE	Physical Chemistry III	3	4
13	VI	6B16 PCH/CHE	Physical Methods in Chemistry	3	3
14	VI	6B17 PCH/CHE	Discipline Specific Elective Course	3	3
15	VI	5B11 PCH/CHE 6B11 PCH/CHE	*Core Course Practicals 3 Gravimetric Analysis	3	5—V Sem 2—VI Sem
16	VI	5B12 PCH/CHE 6B12 PCH/CHE	*Core Course Practicals 4 Organic Chemistry	3	5---V Sem 3---VI Sem
17	VI	6B18 PCH/CHE	*Core Course Practicals5 Physical Chemistry	3	5
18	VI	5B13 PCH/CHE 6B13 PCH/CHE	Project & Industrial Visit	2	1—SemV 1---Sem VI

* External examination will be held at the end of II/ IV/VI semester

Scheme of General Awareness Course (Polymer Chemistry)

No.	Semester	Course code	Title of the Course	Credits	Contact hr/week
1	III	3A11PCH	Polymer Chemistry I	3	3
2	III	3A12PCH	Polymer Chemistry II	3	3
3	III	3A12(A)PCH	Polymer Chemistry II (Practical)	2	-
4	IV	4A13PCH	Polymer Chemistry III	3	3
5	IV	4A13(A)PCH	Polymer Chemistry III (Practical)	2	4
6	IV	4A14PCH	Polymer Chemistry IV	3	3

Scheme for Discipline Specific Elective Course

No	Semster	Course code	Title of the course	Contact hour/ Week	Credit
1	VI	6B17 PCH/CHE -A	Environmental Chemistry	3	3
2	VI	6B17PCH /CHE -B	Applied Chemistry	3	3
3	VI	6B17 PCH/CHE -C	Polymer Chemistry	3	3
4	VI	6B17 PCH/CHE -D	Nano Chemistry	3	3

Scheme of Complementary Elective Course

No	Semester	Course code	Title of the course	Contact hour/ week	Credit
1	I	1C01 PCH/CHE	Chemistry (For Physical & Biological Sciences)	2	2
2	II	2C02 PCH/CHE	Chemistry (For Physical & Biological Sciences)	2	2
3	III	3C03 PCH /CHE (BS)	Chemistry (For Biological Science)	3	2

4	III	3C03 PCH /CHE (PS)	Chemistry (For Physical Science)	3	2
5	IV	4C04 PCH /CHE (BS)	Chemistry (For Biological Science)	3	2
6	IV	4C04 PCH /CHE (PS)	Chemistry (For Physical Science)	3	2
5	I,II, III&IV	4C05 PCH */CHE	Complementary Elective Course Practical	2	4

* External examination will be conducted at the end of IV semester.

Scheme of Generic Elective Course

The Generic Elective course is meant for all the students in the institution except the students of BSc Polymer Chemistry programme. External examination will be conducted at the end of Vth semester.

Options available for Generic Elective Course

No	Semester	Course code	Title of the course	Contact hour/ week	Credit
1	V	5D01 PCH/CHE	Chemistry in Service to man	2	2
2	V	5D02 PCH/CHE	Drugs-Use & Abuse	2	2
3	V	5D03 PCH/CHE	Environmental Studies	2	2
4	V	5D04 PCH/CHE	Nanomaterials	2	2
5	V	5D05 PCH/CHE	Chemistry in everyday life	2	2

Evaluation pattern

Mark system will be followed instead of direct grading for each question. For each course in the semester letter grade, grade point and % of marks are introduced in 7-point indirect grading system as per KUCBCSSUG 2019. Accordingly 20% of the total marks in each course are for Internal Evaluation and the remaining 80% for External Evaluation.

Internal Evaluation (Core , Complementary Elective & Generic Elective)
Components with percentage of marks of Internal Evaluation of theory

Test papers-60%
Seminar/Viva-40%

Internal evaluation is conducted by the concerned Department in mark system. Marks secured for internal evaluation need be send to University.

External Evaluation (Core , Complementary Elective & Generic Elective)
External assessment will include Theory, Practical and Project evaluation conducted by University after the completion of a semester. Duration of theory examination for Core & Complementary courses will be 3 hours, where as for Generic Elective course is 2 hours. The practical examination for Core Course Practical I- Volumetric Analysis will be 3 hours and other Core & Complementary Elective practical exam will be of 4 hour duration.

Project work:
Project works will be carried out in fifth and sixth semesters. Not more than five students can form a group and undertake a project. Each individual student should submit a copy of the project report duly attested by the supervising teacher and Head of the department. The report has to be presented at the time of practical examination conducted at the end of VI semester for evaluation.

Study tour:
Students are required to visit a factory/Laboratory/Research Institute of repute during the course and have to submit the report of the study tour at the end of the sixth semester during the time of practical examination. No credit will be separately given for study tour report.

Practical record, Project report & Study tour report must be certified by the teacher in charge and countersigned by the Head of the Department. Students should submit certified record of respective practical work at the time of University practical examination.

Mark distributions

Table 1: Internal and External marks for Core Courses:

Item	Marks		Total
	Internal	External	
Theory	10	40	50
Practical	10	40	50
Industrial Visit	--	5	5
Project	4	16	20

Table 2: Internal and External marks for Complementary Elective Course

Item	Marks		Total
	Internal	External	
Theory	8	32	40
Practical	8	32	40

Table 3: Internal and External marks for Generic Elective Course

Item	Marks		Total
	Internal	External	
Theory	5	20	25

Table 4: Distribution of Internal marks for Theory courses (Core, Complementary Elective & Generic Elective)

Seminar/Viva	40%
*Test paper	60 %

* At least two test papers are to be conducted and average of these two is to be taken for awarding mark.

Table 5: Distribution of Internal marks for Practical courses

Record + Lab involvement*	50%
Test papers/ Viva	50%

*On completion of each experiment, a report should be presented to the course teacher. It should be recorded in a bound note-book. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, and tables of data collected, equations, calculations, graphs, and other diagrams etc. as necessary and final results.

Table 6: Distribution of internal and external marks for Project

Internal (20% of Total)	%	External (80 % of total)	%
Punctuality	20 %	Relevance of Topic/Statement of Objectives and Methodology	20%
Use of data	20%	Presentation/Quality of analysis and findings	30 %
Scheme and Organization of report	30%	Viva Voce	50%
Viva Voce	30 %		

Distribution of Marks & type of questions for Core Course

<u>Marks including choice</u>:

Unit	Marks

Table 8. Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

Question papers in Physical Chemistry course should contain numerical problems for 20% of the total marks.

Distribution of Marks & type of questions for Complementary Elective Course

<u>Marks including choice</u>:

Unit	Marks

Table 9. Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

Distribution of Marks for Generic Elective Course

Marks including choice:

Unit	Marks

Table 10. Type of Questions & Marks for External Examination – Generic Elective Course

	Total Questions	No. Of Questions to be Answered	Mark for each Marks for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

Guidelines for the Evaluation of Projects

1.Evaluation of the Project Report shall be done under Mark System.

2.The evaluation of the project will be done at two stages:

a) Internal Assessment (supervising teachers will assess the project and award internal Marks

b) External evaluation (external examiner appointed by the University)

c) Marks secured for the project will be awarded to candidates, combining the internal and external Marks

The internal to external components is to be taken in the ratio 1:4. Assessment of different components may be taken as below.

3. The internal to external components is to be taken in the ratio 1:4. Assessment of different components may be taken as below.

Internal(20% of total)		External(80% of Total)	
Components	% of internal Marks	Components	% of internal Marks
Punctuality	20	Relevance of the topic,Statement of Objectives Methodology (Reference/ Bibliography)	20
Use of Data	20	Presentation, Quality of Analysis/Use of Statistical tools, Findings and recommendations	30
Scheme/Organization of Report	30	Viva-voce	50
Viva-Voce	30		

4. Internal Assessment should be completed 2 weeks before the last working day of VIthsemester.

5.Internal Assessment marks should be published in the department.

6.Project evaluation shall be done in the VI semester along with practical exams.

7. Chairman Board of Examinations, may at his discretion, on urgent requirements, make certain exception in the guidelines for the smooth conduct of the evaluation of project.

2.PASS CONDITIONS-

1. Submission of the Project Report and presence of the student for viva are compulsory for internal evaluation. No marks shall be awarded to a candidate if she/he fails to submit the Project Report for external evaluation.

2. The student should get a minimum of 40 % marks for pass in the project.

3. In an instance of inability of obtaining a minimum of 40% marks, the project work may be re-done and the report may be re-submitted along with subsequent exams through parent department.

CORE COURSE: I - THEORETICAL AND INORGANIC CHEMISTRY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
1	1B01PCH	3	3	3

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: State the fundamental assumptions of atomic theory and explain the quantum mechanical model of the atom

CO2: Understand the nature of chemical bonding and analyse the structure of molecules

CO3: Describe the arrangement of elements in the periodic table and relate the arrangement to electronic configuration, bonding, and properties.

CO4: Summerise nuclear disintegration, nuclear fission , fusion and half life period and distinguish natural radio activity, artificial radio activity and artificial transmutation

CO5: familiarise the industrial importance of the compounds like cements, glass and medicines

Contact hours-54

UNIT: 1 ATOMIC STRUCTURE AND INTRODUCTION TO WAVE MECHANICAL CONCEPT (12 hrs)

Bohr theory of atom – calculation of Bohr radius, velocity and energy of an electron. Atomic spectra of hydrogen . Limitations of Bohr theory- Classical mechanics – concept, failure. Black body radiation- Planck's law of radiation. Photoelectric effect- Heisensberg's uncertainty principle and its significance, dual nature of electrons – Davisson and Germer's experiment. - de Broglie hypothesis - Schrodinger wave equation (derivation not expected), - Postulates of quantum mechanics (brief study). Application of Schrodinger wave equation to particle in one dimensional box. – normalization of wave function. Quantum numbers - Shapes of orbitals - Aufbau, Pauli's and Hunds rule - Electronic configuration of atoms.

UNIT: 2 CHEMICAL BONDING (15hrs)

lonic bond: General characteristics, types of ions-Factors effecting the formation of ionic compound - Lattice energy – Born- Lande equation with derivation - Madelung constant, Born Haber cycle and its application - Covalent bond - Valance bond theory and its limitations - Hybridization and shapes of simple molecules (BeF2, PCl3, SF6, CH4, CH3-CH3, CH2=CH2, CH@CH) - VSEPR theory – Shape of molecules and ions (NH3, XeF6, ClF3, NH4+, H3O+) - Molecular orbital theory - homodiatomic molecules and heterodiatomic molecules(HCl and NO)- LCAO method - Bond strength and bond energy - Polarisation and Fajan's rule - Metallic bonding - Free electron and band theory- Fermi level, explanations of metallic properties based on these theories - Weak chemical forces - Hydrogen bond and Vander Waal's forces.

UNIT: 3 GENERAL PROPERTIES OF ELEMENTS (6hrs)

Modern periodic law -long form periodic table Periodicity in properties – Atomic, ionic, covalent radii – ionisation potential,electron affinity, – Electronegativity – Paulings, Mulliken, Allred Rochow's and Mulliken-Jaffe Scale of lectronegativity. Radius ratio – Effective nuclear change –Screening effect – Slater rules, Anomalous behaviour of 1st element of a group –diagonal relationship.

UNIT:4 NUCLEAR CHEMISTRY(12HRS)

Radioactivity - rate of radioactive disintegration –half life- Nature of radiation from radioactive elements – stability of nucleus-binding energy-magic numbers-packing fractions-n/p ratio. Detection and measurement of radioactivity - Gieger-Muller counter - Wilson cloud chamber. Radioactive tracers - Rock dating, Carbon dating - Artificial radio activity - Artificial transmutations of elements - cyclotrons - Induced radio activity - Q values of nuclear reactions - Nuclear reactors Nuclear fission and nuclear fusion - Classification of reactors - Breeder reactor - India's nuclear energy programme.

UNIT 5. CHEMISTRY IN SERVICE TO MAN (9 HRS)

Cement- Classification – Portland cement – Raw materials – manufacture – setting and hardening –
Glass – Different types – manufacture – raw materials – manufacture of ordinary glass – annealing-

Drugs- classification- Sulpha drugs - mode of actions ,examples and uses .Antibiotics-

Discovery, examples and importance. Misuse of antibiotics.
Antipyretics ,analgesics and anti-inflammatory agents , narcotic analgesics Anesthetic, Antiseptic, Anti histamines and tranquillizers, - examples, and abuse..Disinfectant & germicides examples, .importance and uses.

REFERENCES

1 B R Puri, L R Sharma, K C Kalia, *Principles of Inorganic Chemistry*, Milestone

publishers, New Delhi.

2 J.D. Lee, *Concise Inorganic Chemistry*, 5th Edition, Oxford University PressN Delhi, 2008.

3 Cotton F.A. and Wilkinson, *Advanced Inorganic Chemistry*, Wiley Indian Pvt. Ltd., 2008.

4 J.E. Huheey, *Inorganic Chemistry*, Derling Kindersley (India) Pvt. Ltd., 2006.

5 Shriver and Atkins, *Inorganic Chemistry*, W. H Freeman and Company, 2006.

6 Garry L. Milessler and Donald A. Tarr, *Inorganic Chemistry*, Prentice Hall,2003.

7 H.J.Arinikar *Essentials of Nuclear Chemistry*, 4th edition New Age International, New Delhi, 1995.

8 J.B.Rajam *Atomic Physics*, S.Chand and Co.Pvt.Ltd, 1974.

9.Selecteds Topics in Inorganic Chemistry ,Dr.Wahid .U. Malik,Dr. G.D. tuli, Dr. R.D. Madan,S.Chand Publications

10. Jain & Jain , Engineering Chemistry.

11. Shashi Chawla . Atext Book of Engineering Chemistry.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	16
II	16
III	8
IV	15
V	7

Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSE II : ANALYTICAL AND INORGANIC CHEMISTRY – I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
1	2B02PCH	3	3	3

Course Outcomes

On successful completion of this course, students should be able to

CO 1: Determine the error, standard deviation and relative standard deviation of analytical data.
CO 2: Understand statistical treatment of analytical data and the principles underlying volumetric titrations.
CO 3: Understand basic principles behind selective precipitation of cation.
CO 4: Explain the properties of the representative elements on the basis of electronic configuration.
CO 5: Familiarise the theories of acids and bases and the properties of aqueous and non-aqueous solvents
CO 6: Familiarise different types of smart materials.

Contact hours-54

UNIT:I THEORETICAL ASPECTS OF ANALYTICAL CHEMISTRY (10HRS)

Terms used in evaluation of analytical data – significant figures – Rounding of the numerical expression – Errors – Ways to reduce systematic errors Precision and accuracy – Ways of expressing precisions –- Average deviation from the mean - Standard Deviation – Relative standard deviation – Reporting of analytical data- Statistical treatment of analytical data – Population and samples – Confidence limit- Test of significance – students t-test, f-test - Q test for rejecting data.

UNIT:II FUNDAMENTALS OF VOLUMETRIC TITRATIONS AND QUALITATIVE ANALYSIS (8HRS)

Titrimetric analysis – Fundamental concepts – mole, molarity,normality, molality, ppm, and ppb ,mole fraction–
primary standard – secondary standard -standard solutions – quantitative dilution – problems – theory of titrations involving acids and bases,theory of acid-base indicators, – Permangnometry,dichrometry-redox indicators,
iodometry-iodimetry. Indicators – theory of adsorption indicators – complexometric titrations- EDTA titarions-titration curves-

Metal ion indicators.

Applications of solubility product and common ion effect in the precipitation of cations – Interfering acid radicals and their elimination (oxalate, fluoride, borate, phosphate, chromate, arsenite and arsenate).

UNIT:III CHEMISTRY OF REPRESENTATIVE ELEMENTS (14HRS)

Hydrogen : Isotopes (separation method not needed) Ortho and para hydrogen. Hydrides and their classification.

Alkali and alkaline earth metals: Periodic properties of hydrides, oxides, halides, hydroxides and carbonates.

P block elements

Comparative study based on electronic configuration - periodic properties of Hydrides,Oxides, Halides, Carbides and Oxoacids. Inert pair effect.Metallic and non-metallic character-Acid-base properties of oxides. Exceptional behaviorof second period element in the following groups of elements-Group13 (B,Al,Ga,In andTl).

Group14 (C,Si,Ge,Sn and Pb) Group15 (N,P,As,Sb and Bi). Group16 (O,S,Se,Te and Po) and Group17 (F,Cl,Br and I).

UNIT:IV ACIDS AND BASES (12HRS)

Concepts of Lowry and Bronsted – Lux – Arrhenius concept, flood concept – The solvent system concept – The Lewis concept – Relative strength of Acids and Bases – Effect of solvent – Leveling effect –Effect of polarity and substituents – Hard and soft acids and bases – Pearsons concept –Bonding in hard–hard and soft–soft combinations – HSAB principle and its applications –Basis for hard- hard and soft–soft interactions.

Classification of solvents – characteristic properties of a solvent – study of liquid ammonia, liquid HF and H2SO4.

UNIT 5. SMART MATERIALS (10 HRS)

Shape memory alloys, Piezoelectric materials, Electrostrictive and Magnetostrictive materials, Thermochromic and photochromic, pH-sensitive Polymers, Halochromic materials, Photomechanical materials, Self-healing materials, Smart fabrics, Magnetic shape memory and Thermoelectric materials with examples. Nano devices.

REFERENCES

1 G D Christian, *Analytical Chemistry*, John Wiley and Sons..

2 G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denny, *Vogel's Text book of Quantitative Chemical Analysis*, 5th Edn., ELBS, 1989.

3 Vogel's *Text Book of Qualitative Analysis*

4 DA Skoog, DM West, *Analytical Chemistry, An Introduction*, 4th Edn., CBS

Publishing Japan Ltd., 1986.

5 Puri, Sharma and Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers and Distributors, 2008.

6 J.D.Lee, *Concise Inorganic Chemistry*, 5th edition , Oxford University Press, New Delhi 2008.

7 R.Gopal, *Inorganic Chemistry for undergraduates*, Universities press, India Pvt.Ltd, 2009.

8 P. L.Soni, *Text book of inorganic Chemistry*, S.Chand and Sons, 2007.

9 Shriver and Atkins, *Inorganic Chemistry*, W. H Freeman and Company, 2006.

10 Huheey J. E, *Inorganic Chemistry*, Prentice Hall 1993

11. M.V.Gandhi, Brian S.Thompson Champan and Hall, Smart materials

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks	Unit	Marks
I	14	III	16	V	8
II	10	IV	14		

Table 8. Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSE IV : ORGANIC CHEMISTRY – I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
1II	3B04PCH/CHE	3	3	3

COs for ORGANIC CHEMISTRY I

On successful completion of this course, students should be able to

CO: 1) Explain the types of electron displacement in organic molecules and predict the properties of molecules based on electron displacement effect

CO:2) Understand the concept of aromaticity , distinguish aromatic , anti aromatic and non aromatic compounds and ions and Illustrate the mechanism of aromatic electrophylic substitution

CO: 3) Classify stereo isomers, understand the property of chirality , apply CIP rules to recognize the configuration and explain the stabilityof conformations drawing energy profile diagram

CO: 4) Explain the mechanism of polymerization, synthesis and application of industrially important Polymers

CO :5) Explain the classification and the methods of preparation of important dyes

CO :6) Illustrate the preparative methods and synthetic applications of important synthetic reagents

Hours-54

UNIT I- INTRODUCTION TO REACTION MECHANISM (12 HOURS)

Representation of structural formulae -Bonding notations - Drawing electron movements with arrows-curved arrow notation

- Half headed and double headed arrows. Types of reagents – electrophiles and nucleophiles, Types of organic reactions,

Electronegativity- Polarity in bonds- Homolytic and Heterolytic bond fission - Reaction intermediates-Carbocations, Carbanions, Free radicals, Carbenes and Nitrenes - Their generation, Structure and stability. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereo chemical studies).

Electron displacement in organic molecules- inductive effect, Electromeric effect, Resonance or Mesomeric effect and Hyper conjugation- Steric effect- Tautomerism

Application of electron displacement effect in the order of acidity of Carboxylic acids, Phenol and Basicity of amines- Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine . - comparative basic strength of aniline, N- methylaniline and N,N- dimethyl aniline (in aqueous and non- aqueous medium), steric effects and substituent effects. Application of steric effect in the basicity of substituted aromatic amines -Explanation of Order of stability of carbonium ions, Free radicals ,carbanions, carbenes.

UNIT II-AROMATICITY (8 HOURS)

Structure of Benzene - Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. - ferrocene- Annulenes. Aromaticity in higher annulenes . Anti aromaticity and homoaromaticity.

Mechanism of aromatic electrophilic substitution-Halogenation, Nitration and Sulphonation - Friedel -Craft's alkylation and acylation—Orientation and reactivity in monosubstituted benzene rings- Ortho/para ratio.

UNIT III-STEREOCHEMISTRY: (15 HOURS)

Fischer Projection, Newman and Sawhorse Projection formulae and their inter-conversions; Geometrical isomerism: cis-trans and, syn-anti isomerism

Optical Isomerism: Optical activity: Definition, wave nature of light, plane polarised light, optical rotation and specific rotation, chiral centers. Chiral molecules: definition and criteria - absence of plane, center and Sn axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and disymmetric molecules (trans-1,2-dichlorocyclopropane). optical isomerism in compounds without any stereo centers (allenes, biphenyls);

Molecules with constitutionally symmetrical chiral carbons (Tartaric acid) Molecules with constitutionally unsymmetrical chiral carbons (2,3-dibromopentane). D, L &, R, S configuration, Cahn-Ingold-Prelog rules. Racemic mixture, Racemisation and Resolution techniques. Geometrical isomerism with reference to alkenes and cyclo alkanes– cis, trans and E, Z configuration.

Conformational analysis : Definition and examples of conformational and configurational isomers. Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes- Conformational analysis of ethane, n-butane, 1,2-dichloroethane,2-chloroethanol - Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams., conformation of mono and disubstituted cyclohexane derivatives,

UNIT IV- POLYMERS : (6 HOURS)

Introduction and classification of polymers; Number average molecular weight, Weight average molecular weight, Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics - thermosetting (phenol-formaldehyde, Polyurethanes) and thermo softening (PVC, polythene –LDPE and HDPE) – polyamides, Polycarbonates, and silicone polymers. Rubbers - natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives;

Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.

UNIT V- DYES (5 HOURS)

Synthetic Dyes : Colour and constitution- Chromophores and auxochrome. Classification of dyes, Synthesis of Methyl orange, Malachite green, and Alizarin. Edible Dyes with examples

UNIT VI - SYNTHETIC REAGENTS (8 HOURS)

Active methylene group- Preparation and synthetic application of Ethyl acetoacetate, - Preparation and synthetic application of Aluminium isopropoxide, N-Bromo Succinamide , Diazo methane and Wittig reagent. Reformatsky reaction and its application

References

1. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', Visal Publishing Company Co.

2. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', Vikas Publishing House

3. B. S. Bahl 'Advanced organic Chemistry', S. Chand.

4. Peter Sykes, 'A Guide book to Mechanism in Organic Chemistry' , Pearson Education

5. P. S. Kalsi' 'Organic Reactions and their Mechanisms'' New Age International Publishers

6. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', Prentice Hall of India

7. I. L. Finar, 'Organic Chemistry', Vol.- I, Pearson Education

8. Gowariker V.R., Viswanathan N.V. and Jayader Sreedhar,' Polymer Science', Wiley Eastern Ltd., New Delhi.

9. Billmeyer, F. W. Textbook of Polymer Science, John Wiley & Sons, Inc.4. Gowariker, V. R.; Viswanathan

Further Reading

1. P. Y. Bruice, 'Organic Chemistry', Pearson Education.

2. J. March, 'Advanced Organic Chemistry', John Wiley & Sons, NY

3. S. H. Pine 'Organic Chemistry', McGraw Hill

4. J. Clayden, N. Greeves, S. Warren and P. Wothers, 'Organic Chemistry', Oxford University Press

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks
I	16	IV	8
II	10	V	4
III	16	VI	8

Table 8. Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSE VI : ORGANIC CHEMISTRY – II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
1V	4B06PCH/CHE	3	3	3

COs for ORGANIC CHEMISTRY II

On successful completion of this course, students should be able to

CO : 1) i) Describe mechanisms for substitution and elimination reactions, and predict the effect of nucleophile, leaving group, and solvent on the relative rates of S_N1 versus S_N2 reactions, and E1 versus E2 reactions, as well as on the relative rates of substitution versus elimination.

ii) Explain Chugaev and Cope eliminations and E1CB mechanism

CO : 2) Illustrate the preparative methods and important properties of Hydro carbons, halogen compounds , Hydroxy compounds and Carbonyl Compounds

CO: 3) Explain the mechanism of important name reactions including rearrangements involving hydroxyl and Carbonyl functional groups

54 HOURS

UNIT I- MECHANISM OF ORGANIC REACTIONS (12 HOURS)

Substrate and reagent- Electrophiles and nucleophiles- Aliphatic nucleophilic substitutions-mechanism of SN1,SN2- Stereo Chemistry of S_N1 and S_N2 reaction- Walden Inversion- Effect of nucleophile, leaving group, and solvent on the relative rates of S_N1 versus S_N2 reactions

Elimination - E1 and E2 mechanism - mechanism of dehydration of alcohol and dehydrohalogenation of alkyl halides - Saytzeff rule and Hofmann's rule.Effect of nucleophile, leaving group, and solvent on the relative rates of and E1 versus E2 reactions and on the relative rates substitution versus elimination.

E1CB mechanism- Thermal elimination reactions- Chaugaev and Cope elimination

Mechanism of Electrophilic addition of Hydrogen halides to Carbon- Carbon double bond- Markownikoff's rule - Kharasch effect (Free radical addition of HBr on unsymmetrical double bond)

UNIT 1I - HYDROCARBONS (14 HOURS)

Alkanes –Nomenclature , Preparation by Reduction of alkyl halides and Wurtz reaction and Kolbe's electrolytic method.

Alkenes - Nomenclature Preparation by dehydration of alcohols, dehydrohalogenation of alkylhalides, dehalogenation of vicdihalides and by Kolbe's electrolytic method.

Reactions- Hydrogenation, addition of halogens, halogen acid and water. Oxidation with KMnO4, $K_2Cr_2O_7$ and Osmium tetroxide, Ozonolysis and polymerization.

Alkynes- Nomenclature Preparation by dehydrohalogenation of vic-dihalides and gem- dihalides, dehalogenation of tetrahalides and Kolbe's electrolytic method. Reactions- Addition of Hydrogen, Halogen, Halogen acid and water – oxidation using alkaline $KMnO_4$, Acidic $K_2Cr_2O_7$ and Seleniumdioxide, Ozonolysis, hydroboration-oxidation and Polymerization reactions specific to alkynes.

Dienes- Nomenclature-Conjugated, cumulated and isolated dienes with example, preparation of 1, 3 butadiene-by dehydration of diols. Reactions of 1, 3 butadiene - 1,2 and 1,4 additions, polymerization.

Polynuclear Hydrocarbons- Haworth Synthesis of naphthalene, synthesis of Anthracene from benzyl chloride.

Cycloalkane – Nomenclature- Methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane).

UNIT III - HALOGEN COMPOUNDS (5 HOURS)

Halogen compounds: Nomenclature - Alkyl and Aryl Halides:

Classes of alkyl halides, Methods of formation and chemical reactions of gem and vic-dihalides, Polyhalogen compounds : Methods of formation of Carbon tetrachloride and Chloroform.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Relative reactivity of alkyl, allyl /benzyl, vinyl and aryl halides towards nucleophilic substitution reactions., nucleophilic aromatic substitution; SNAr and Benzyne mechanism.

UNIT IV - HYDROXY COMPOUNDS (8 HOURS)

Alcohols – Nomenclature, Preparation of monohydric alcohols from carbonyl compounds using Grignard reagents - Preparation with hydro-boration reaction, Ascent and Descent in alcohol series, Methods to distinguish 1^o, 2^o and 3^o alcohols - Lucas method, Victor Meyer's method and oxidation method .

Glycerol- Isolation from fats and oils ,Preparation from Propene- Reactions – a) Oxidation b) Reduction with HI, c) Dehydration d) Nitration e) Acetylation

Phenols - Acidic character of phenol - Preparation of phenol from i) diazonium salt, ii) aryl sulphonates, iii) cummene. Important reactions of Phenol - Bromination, Kolbe-Schmidt reaction, Riemer-Tiemann reaction, Hauben-Hoesch reaction, Gattermann-Koch reaction ,

FeCl3 reaction. azo coupling. Naphthols- Preparation of Alpha and Beta Naphthols

Mechanism of following rearrangement reactions - a) Pinacol-Pinacolone rearrangement b) Fries rearrangement c) Claisen rearrangement.

UNIT V - CARBONYL COMPOUNDS (15 HOURS)

Nomenclature of aldehydes and ketones - Preparation of aldehydes and ketones - Rosenmund's reduction, Stephen's reduction, Etard's reaction, Oppeanauer oxidation, Houben - Hoesh synthesis. Reactions of aldehydes and ketones. Reduction using $LiA1H_4$ and $NaBH_4$ MPV, Clemensen and Wolf-Kishner reduction. Reduction to pinacols - Oxidation using mild and strong oxidizing agents - SeO_2 oxidation - Reaction with alcohols, KCN, sodium bisulphite and derivatives of ammonia - Distinction between acetaldehyde and benzaldehyde and acetaldehyde and acetone.

Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisan-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements

Addition reactions of unsaturated carbonyl compounds: Michael addition.

References

1. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry' 3rd Edition, Visal Publishing Company Co.

2. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House

3. B. S. Bahl 'Advanced organic Chemistry', S. Chand.

4. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India.

5. I. L. Finar 'Organic Chemistry', Vol.- 1, Pearson Education

6. P. S. Kalsi' 'Organic Reactions and their Mechanisms'' New Age International Publishers

7. Graham Solomons, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry,* John Wiley & Sons (2014).
8. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

Further Reading

1. P. Y. Bruice, 'Organic Chemistry', Pearson Education.

2. J. March, 'Advanced Organic Chemistry', John Wiley & Sons, NY

3. S. H. Pine 'Organic Chemistry', McGraw Hill

4. J. Clayden, N. Greeves, S. Warren and P. Wothers, 'Organic Chemistry', Oxford University Press

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	16
II	14
III	6
IV	10
V	16

Table 8. Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSE VII : Analytical and Inorganic chemistry-II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B07PCH/CHE	3	4	3

CourseOutcomes

On successful completion of this course, students should be able to

CO: 1 Understand the qualitative and quantitative aspects of analysis and separation techniques
CO: 2 Explain instrumentation and working principle of different analytical techniques –TGA, DTA and radio chemical method of analysis.
CO: 3 Familiarize with the preparation, properties and uses of some inorganic compounds like hydrides of boron, sulphur and silicon based inorganic polymers and understand their importance
CO :4 Explain the classification of refractories.
CO :5 Know the position, electronic configuration and physical properties of noble gases and explain hybridization and geometry of different xenon compounds
CO :6 Explain various steps involved in metallurgical operations and power metallurgy and understand Corrosion, theories of Corrosion and factors affecting Corrosion

SEMESTER V
ANALYTICAL AND INORGANIC CHEMISTRY-II

Contact hours:54

Unit: I - Principles of Gravimetric Analysis and Separation-Chemistry. (9hrs)

Gravimetric analysis – unit operations in gravimetric analysis.

. **Precipitation**: Conditions of precipitation – co precipitation and post precipitation

Principle of gravimetric estimation of iron and nickel

Chromatography -Basic principle, Column chromatography – Adsorption column chromatography and Partition column chromatography - Ion exchange chromatography -Ion exchange resins.

Thin layer chromatography--preparation of chromatoplate- running a thin layer chromatogram- location of spots.

Brief introduction on Gel chromatography and paper chromatography-

Solvent extraction: Principle – factors affectin solvent extraction- factors favouring solvent extraction different types-batch, continuous, counter current

Unit: II- Instrumental Techniques in Analytical Chemistry (9hrs)

Thermogravimetric analysis – introduction – instrumentation – factors affecting TGA – application of TGA. Differential thermal analysis – introduction – instrumentation – principle of working – factors affecting DTA – application. Thermometric titrations – a brief study. Radio chemical methods of analysis – introduction – activation analysis – a brief study. Neutron diffraction – theoretical aspects – thermal neutron – instrumentation – application.

Unit: III- Industrially important Inorganic compound (9hrs)

Structure ,properties and uses of:

Hydrides of boron – B2H6 and B4H10(preparation also). Borazine, Boric acid, oxoacids of halogens, Inter halogen compounds, Pseudo halogens, Fluorocarbons.

Inorganic polymers

Phosphorous based, sulphur based and silicon based - silicones and silicates - polymers.

Refractories

Introduction- classification- super refractories - silicon carbide. Pure oxide refractories.

Unit: IV-Chemistry of Noble Gases(9hrs)

Discovery of noble gases. Electronic configuration and position in the periodic table. General physical properties, uses of noble gases. Compounds of noble gases– Clathrates, compounds of Xenon—XeF2, XeF4, XeF6, XeO2F2 , XeOF2, XeOF4 and XeO3. hybridization and geometry of these compounds. Fluorides of Krypton and Radon.

Unit: V- Metallurgy(9hrs)

Occurrence of metals.Various steps involved in metallurgical processes. Electrometallurgy, Hydrometallurgy.

Coinage metals-Occurrence and extraction of copper, silver and gold.

Powder metallurgy(brief discussion). Alloy steels- composition of alloy steels-application of alloy steels. Heat treatment of steel. Nonferrous alloys and their uses.

UNIT VI . Corrossion and corrosion control (9hrs)

Introduction.. Causes of corrosion.types and Theories of corrosion-(Direct chemical attack or dry corrosion. Electrochemical theory or wetcorrosion. Peroxide theory,acid theory ,oxide theory) .Differential Aeration or concentration cell corrosion.

Factors influencing corrosion- nature of the metal- nature of the environment. Corrosion control.

References :

1.B R Puri, L R Sharma, K C Kalia, *Principles of Inorganic Chemistry,*Milestone publishers, New Delhi.

2. D A Skoog, D M West and S R Crouch, *Fundamentals of Analytical Chemistry,* 8th Edition, Brooks/Cole Nelson (Chapter 12-17).

3. Vogel's *Text Book of Quantitative Chemical Analysis*, 6th Edition, Peasons education limited.

4. Vogel's *Text Book of Qualitative Analysis*

5. G D Christian, *Analytical Chemistry,* John Wiley and Sons..

6. J.D Lee, *Concise inorganic chemistry,* Blackwell Science, London

7. Jain & Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Company.

8. Chatwal and Anand, *Instrumental methods of chemical analysis.*

9. A K Srivastava, P C Jain, *Instrumental approach to chemical analysis*. S Chand.

10.H. Kaur, *Instrumental methods of chemical analysis,* PragatiPrakashan, Meer

11. Emelus and Anderson, *Principles of Inorganic Chemistry.*

12. R. P. Budhiraja , *Separation Chemistry* , Second edition, New age international publishers

13. Dr. S.K.Agarwala and Dr. Keemtilal, *Advanced Inorganic Chemistry.*

14.B.K. Sharma, Industrial Chemistry

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks
I	10	IV	12
II	10	V	12
III	8	VI	10

Table 8. Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSE VIII : INORGANIC CHEMISTRY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B08 PCH/CHE	3	4	3

Course outcomes

On successful completion of this course, students should be able to

CO: 1) Understand the behavior of transition and inner transition elements and explain the separation of lanthanides by ion exchange method and lanthanide contraction

CO: 2) Understand key features of co-ordination compounds and illustrate the theories of coordination complexes, stability of complexes and explain factors affecting crystal field splitting.

CO: 3) Explain biological functions of metal ions.

CO: 4) Familiarize new elements in periodic table and Understand recent developments in inorganic chemistry.

SEMESTER V

INORGANIC CHEMISTRY

Contact hours:54

UNIT I. TRANSITION AND INNER TRANSITION ELEMENTS.(14hrs).

General properties of transition elements – Electronic configurations,Oxidation states, colour, magnetic properties, tendency to form complexes and catalytic properties.

Comparison of first transition series with second and third series.

Lanthanides – Occurrence , separation by ion - exchange chromatography. Electronic configurations, oxidation states, magnetic properties and spectra of lanthanides. Lanthanide Contraction—causes and consequences.

Actinides : Electronic configurations, oxidation states, spectra and magnetic properties.Trans actinide elements – Preparation, IUPAC nomenclature. Comparison of transition and inner transition elements

UNIT II. COORDINATION CHEMISTRY- I (9hrs)

Introduction-Double salts and Coordination compounds. Nomenclature. Effective Atomic Number (EAN). Shapes of d orbitals.-Types of ligands. Chelates. Stereo chemistry of

coordination compounds with coordination numbers 2 to 6. Isomerism. Stability of complex ions-stability constant. Factors affecting the stability of complexes. Application of complex formation in qualitative and quantitative analysis.

UNIT III. COORDINATION CHEMISTRY- II (9hrs)

Theories of bonding in transition metal complexes– Valence bond theory . Application to some complexes-Hybridization in tetrahedral, square planar and octahedral complexes – explanation of magnetic properties based on VBT. Limitations of VBT. Crystal field theory-Crystal field splitting in octahedral, tetrahedral and square planar geometries. Factors affecting the magnitude of crystal field splitting. Crystal field stabilization energy(CFSE). Explanation of colour, spectral and magnetic properties . Spectrochemical series.

UNIT IV. BIOINORGANIC CHEMISTRY(9hrs)

Myoglobin and Haemoglobin - Structure and functions of haemoglobin and myoglobin. Cooperativity effect.Bohr effect,. Metallo enzymes of
iron and zinc (structural details not needed). Metal ion transport across cell membrane – sodium/potassium pump. Biological functions of Co, Mn, Zn,Mg and Ca and toxicity of -,As, Cd, Pb, Hg . Biological fixation of nitrogen.

UNIT V. ORGANOMETALLIC COMPOUNDS (9hrs)

Introduction. Classification based on the nature of metal-carbon bond.
Preparation ,structure - valence bond theory - of mononuclear (Ni,Fe), binuclear (Fe,Mn,Co) and trinuclear (Fe) metal carbonyls - Application of 18 electron rule to predict M-M bond.
Preparation, properties, structure and bonding of Ferrocene.

UNIT VI . RECENT ADVANCES INORGANIC CHEMISTRY (4Hrs)

New elements in periodic table **:** Elements with atomic numbers-113,115,117,118. -Note on discovery and naming.
Elementary idea on : Graphene and borophene - Shape memory alloys- Mxenes- geopolymers.

REFERENCES

1. D. F. Shriver and P.W. Atkins, Inorganic Chemistry 3rd edn., Oxford University Press.
2. R. C. Mehrothra and A. Singh, Organometallic chemistry, New age publishers.
3. J. E. Huheey, E. A. Keiter, R. L. Keiter, O K Medhi, Inorganic Chemistry, Pearson.
4. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.

5. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry 5th edn., John Wiley, New York.

6. J. D. Lee, Concise Inorganic Chemistry 5th edn., Blackwell Science, London.

7. R.A. Mackay, W. Henderson, Introduction to Modern Inorganic Chemistry, 6th edition . Nelson Thornes Ltd.

Internet links for reference:

1.https://iupac.org/iupac-is-naming-the-four-new-elements-nihonium-moscovium-tennessine-and-oganesson/

2. https://iupac.org/wp-content/uploads/2016/06/Press-Release_Naming-Four-New-Elements_8June2016.pdf

3. http://www.rsc.org/periodic-table/

4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4922135/

5. https://phys.org/news/2018-12-borophene-advances-d-materials-platform.html

6. https://www.geopolymer.org/science/introduction/

7. https://nano.materials.drexel.edu/research/synthesis-of-nanomaterials/mxenes/

8. https://ceramics.org/ceramic-tech-today/basic-science/research-on-mxenes-expandand-so-do-the-mxenes

9. https://www.sciencedirect.com/topics/materials-science/shape-memory-effect

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks
I	14	IV	10
II	10	V	10
III	12	VI	6

Table 8. Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSE IX : PHYSICAL CHEMISTRY I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B09 PCH/CHE	3	4	3

Course outcome

On successful completion of this course, students should be able to

CO1) Know the fundamental idea about gaseous state and familiar with different equations related to gaseous state and explain applications of theories of gaseous state

CO2) Compare different theories of liquid state and identify the properties of liquid state.

CO 3) Understand the properties of ideal and non-ideal solutions and explain phase equilibrium

CO4) Explain colligative properties of dilute solution and determine the molecular weight of a solute

CO 5) Identify different crystallographic systems and various types of crystal defects

CO 6) Describe X ray diffraction to explain internal structure of solids

Credit- 4 Contact hrs 54

UNIT 1 The Properties of Gases (15 hrs)

Gas laws – The general gas equation– The Kinetic model of gases – gas laws from the kinetic theory of gases ---Molecular Speeds – Maxwell's distribution of molecular speeds – Most probable velocity, average velocity and root mean square velocity — Collision diameter – Mean free path, Collision number and collision frequency – Degrees of freedom of a gaseous molecule – Principle of equipartition of energy and contribution towards heat capacity of an ideal gas.
Real gases – Molecular attractions – The compressibility factor – virial equation of state – Van der waals equation expressed in virial form – calculation of Boyle's temperature – Isotherm of real gases and their comparison with Van der waals isotherms – continuity of states – critical phenomenon – critical constants of a gas and its determination,derivation of relationship with vander waal constants.
–Determination of molecular mass by limiting density method – Principle of corresponding states – Liquefaction of gases by Joule Thomson effect.

UNIT 2 Liquid State (7hrs)
Theories of Liquids state, Vacancy Theory and Free volume theory- Properties of liquids– vapour pressure, Heat of vapourisation, Trouton's Rule ,Surface tension and its determination – Interfacial tension – surface active agents
–effect of temperature on surface tension- Parachor and its applications – Viscosity -determination of

coefficient of viscosity and its variation with temperature – refractive index – specific and molar refraction – Measurement of refractive index – Abbe's refractometer – optical activity and its measurement using Polarimeter.

UNIT 3 Solid State (16 hrs)

Amorphous and crystalline solids – Laws of crystallography – Law of constancy of interfacial angles – Law of constancy of symmetry – Law of rationality of indices – space lattice and unit cell – Miller indices –seven crystallographic systems – Bravais lattices – Spacing of lattice planes in simple cubic, body centred and face centred cubic systems – Number of particles per unit cell in each of these - Calculation of Avogadro number, density and molecular mass from crystallographic data. Determination of internal structure of crystals by X-ray diffraction methods – derivation of Bragg's equation – Bragg's rotating crystal method and De bye Scherrer Powder diffraction method – Crystal structure of NaCl – anomalous nature of diffraction pattern of KCl. Co-ordination Number – Efficiency of packing – Cubic and Hexagonal packing – Radius ratio rule – Tetrahedral and Octahedral voids. Liquid crystals – types – Examples – applications .
crystal defects-point defects-Schottky and Frenkel defrcts-non stoichiometric defects.

UNIT 4 Solutions (16 hrs)

Types of solutions and methods for expressing concentration – Liquid systems — Completely miscible-Ideal and non- ideal solutions – Raoult's Law – Vapour pressure – composition diagrams-Azeotropic mixtures– Temperature – composition curves – Partially miscible liquids –Upper and Lower Critical solution temperature –Immiscible liquids – Steam distillation – Molar mass from steam distillation – Dilute Solutions Colligative properties – Lowering of vapour pressure and Raoult's law – Calculation of molar mass. Elevation of boiling point – relation to lowering of vapour pressure – Thermodynamic derivation – Calculation of molar mass –Depression of freezing point – Thermodynamic derivation – Calculation of molar mass – Measurement by Beckmann's method – Osmotic pressure – Measurement by Berkely and Hartley's method – Laws of Osmotic pressure – Van't Hoff equation – Calculation of molar mass – Abnormal molar mass – Van't Hoff factor – Degree of dissociation and association and their calculation from colligative properties. Gas Liquid system — Henry's Law

References

1. Physical Chemistry : P.W. Atkins, Oxford University Press

2. Physical Chemistry : Puri, Sharma and Pathania, Vishal Publishing Co.

3. A Text book of Physical Chemistry: A S Negi and S C Anand, New Age International Publishers.

4. A Textbook of Physical chemistry: K. L. Kapoor, Volume 1, Macmillan India Ltd
5. Text book of Physical Chemistry : Samuel Glasstone, McMillan Press Ltd.

6. Advanced Physical Chemistry: Gurdeep Raj, Goel Publishing House, Meerut.

7. Physical Chemistry: W.J. Moore, Orient Longmans.

8. Physical Chemistry: N. Kundu & S.K. Jain, S.Chand & Company

9. Solid state chemistry and its applications-Antony. R .West

10. Solid state chemistry by Lesley E. Smart and Elaine A. Morre

11. Introduction to solids Leonid V Azaroff

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	17
II	9
III	18
IV	18

Table 8. Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

Question papers in Physical Chemistry course should contain numerical problems for 20% of the total marks.

CORE COURSE X : PHYSICAL CHEMISTRY II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B10 PCH/CHE	3	4	3

Course outcome

On successful completion of this course, students should be able to

CO 1) Understand the laws of thermodynamics and its relation to universe, principles of thermo chemistry and chemical equilibrium.

CO2) Identify the parameters for spontaneous chemical reactions and predict feasibility of reactions.

CO3) Understand the concept of entropy and how the whole universe is related to it.

CO 4) Construct phase diagrams and study the equilibrium exists between various states of matter. and apply principles phase diagram to separation processes and for property modification of different type of system.

CO 5) Understand basic principles of surface chemistry and its application in various fields

CO 6) Prepare different types of colloidal particles and to explore the applications in day today life.

Contacthrs54

UNIT 1 Thermodynamics-I (15hrs)

Basic concepts -- study of terms -- system and surroundings -- open, closed and isolated systems,isothermal,isochoric – adiabatic systems- state and state variables -- macroscopic properties – intensive and extensive properties – isothermal, adiabatic, isochoric and isobaric processes -- reversible and irreversible processes – work , heat and energy – state functions and path functions – exact and inexact differentials with notations – internal energy and enthalpy –-- zeroth law of thermodynamics – concept of temperature. statement of first law of thermodynamics – conservation of energy – expansion work – general expression for work – work done during free expansion, expansion against

constant pressure and isothermal reversible expansion – Heat capacity of gases at constant volume Cv and constant pressure Cp – relation between Cp and Cv and its derivation – P, V,T relations during adiabatic process -- work done during reversible adiabatic expansion-comparison for isothermal and adiabatic process -- Change in enthalpy at constant pressure -- Joule Thomson effect -- internal pressure -- inversion temperature.
Thermochemistry – standard enthalpy changes for physical and chemical changes –enthalpy of neutralisation,transition,formation,phase changes,combustion and solution- heats of reaction at constant volume qv and constant pressure qp – relation between qp and qv – Hess's law and its applications –bond energy calculations-variation of of reaction with temperature – Kirchoff equation.

UNIT 2 Thermodynamics –II(12hrs)

Limitations of first law – cyclic process – Carnot cycle – efficiency of heat engine – statement of second law of thermodynamics in terms of work and heat-Clausius,Kelvin Planck statement- concept of entropy -- physical significance of entropy (microscopic)– variation of entropy of ideal gases with pressure and temperature – second law in terms of entropy – entropy change for phase transitions – criteria for spontaneous changes-for isolated system at costant (T&V), (T&P), (S&V), (S&P)– Gibbs and Helmholtz free energies – condition of spontaneity in terms of free energy – comparison of entropy and free energy – Gibbs- Helmholtz equation – Maxwell relations
– Partial molar properties – concept of free energy – Gibbs Duhem equation – variation of chemical potential with temperature and pressure ..Chemical potential of a component in a mixture of ideal gases—Clapeyron equation- Clausius- Clapeyron equation for all phase equilibria-concept of fugacity.
Third law of thermodynamics—Nernst heat theorem – absolute entropy – calculation of absolute entropies.

UNIT 3 Chemical Equilibrium(8 hrs)
Law of mass action-equilibrium constant – Relation between Kp, Kc and Kx –Thermodynamic treatment of the law of mass action – Vant Hoff reaction isotherm –Temperature dependence of the equilibrium constant – The Van't Hoffs isochore– Pressure dependence of the equilibrium constant Kp– Study of heterogeneous equilibria – Factors that
change the state of equilibrium – Le –chatelier's principle and its application to chemical and physical equilibria. Mention homogeneous gaseous equilibria having zero, positive and negative values of Δn. Calculation of degree of dissociation and Kp. Heterogeneous equilibria –Dissociation of solid calcium carbonate and decomposition of solid NH4HS.

UNIT 4 Phase Rule (10 hrs)
Statement of distribution law and explanation of terms (component,degree of freedom,phase)-thermodynamic derivation - one component systems – water system and sulphur system (including meta stable equilibrium)- two component systems – reduced phase rule --- simples eutectic systems—lead-silver system --- desilverisation of lead--- KI –water system --- freezing mixtures--- systems involving the formation of compounds with congruent and incongruent melting points.—ferric chloride water system and Na2SO4 water system..—solid-gas equilibria --- decomposition of CuSO4.5H2O.—deliquescence and efflorescence.. Nernst distribution law.. thermodynamic derivation and derivation from phase rule. Limitations--- modifications under special conditions.—applications of distribution law to study association and dissociation of salts, solvent extraction, hydrolysis of salts and equilibrium constant of the reaction KI + I2 =KI3.

UNIT 5 Colloids, Surface Chemistry (9 hrs)

Colloids, Classification – preparation – structure and stability – The electrical double layer –Zeta potential (no derivation)– Properties of Colloids – Tyndall effect – Brownian movement– Coagulation of colloidal solution – Hardy – Schulze rule – Flocculation value – Electro kinetic properties – Electrophoresis – Electro-osmosis – Protective colloids – Gold number -Emulsion – Oil in water emulsion and water in oil emulsion – Emulsifying agents – Gels –Micelles-CMC-Donnon membrane equilibrium (basic idea only)

Physical and chemical adsorption – Adsorption isotherms – Freundlich adsorption isotherm –effect of temperature on adsorption – Langmuir adsorption isotherm -thermo dynamic derivation – use and limitation.B.E.T. equations (B.E.T. no derivation) – Gibbs adsorption equation(no derivation)-Surface films - Determination of surface area using Langmuir equations.

References

1. Physical Chemistry : P.W. Atkins, Oxford University Press
2. Physical Chemistry : Puri, Sharma and Pathania, Vishal Publishing Co.
3. A Text book of Physical Chemistry: A S Negi and S C Anand, New Age International Publishers.
4. A Textbook of Physical chemistry: K. L. Kapoor, Volumes 2 &3, Macmillan India Ltd
5. Text book of Physical Chemistry : Samuel Glasstone, McMillan Press
6. Advanced Physical Chemistry: Gurdeep Raj, Goel Publishing House, Meerut.
7. Physical Chemistry: W.J. Moore, Orient Longmans.
8. Physical Chemistry: N. Kundu & S.K. Jain, S.Chand & Company.
9.Chemical Thermodynamics: J.Rajaram and J.C.kuriacose,Pearson.
10.Physical Chemistry: A Molecular Approach by Donald A Mc Qurrie
11. Physical chemistry by G W Castellan.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks
I	17	IV	12
II	14	V	10
III	9		

Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

Question papers in Physical Chemistry course should contain numerical problems for 20% of the total marks.

CORE COURSEXIV: ORGANIC CHEMISTRY - III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B14PCH/CHE	4	4	3

On successful completion of this course, students should be able to

CO1 Acquaint with the classification, structures and properties of carbohydrates, explain the configuration of glucose and fructose, their inter conversion , illustrate Killiani-Fischer synthesis and Ruff degradation

CO2 Illustrate the preparative methods and the properties of different classes of organic acids , nitrogen containing compounds and heterocyclic compounds .

CO3 Classify amino acids and peptides and explain the synthesis of simple peptides by *N*-protection (t-butyloxycarbonyl and phthaloyl) &C-activating groups and Merrifield solid-phase synthesis. Explain the methods of determination of primary structure of peptides

CO4 Distinguish the components of nucleic acids and lipids and their roles in biological system and the biological importance of various natural products . Familiarise with important drugs and their therapeutic applications

CO 5 Recognise the types and characteristics of pericyclic reaction and analyse the pericyclic reactions by FMO methods. Understand the photochemistry of carbonyl compounds

CO 6 Understand the principles of Green Chemistry and the importance of green synthesis and recognize the impact of green chemistry on human health and the environment

ORGANIC CHEMISTRY III

72 HOURS

UNIT 1 CARBOHYDRATES (12 HOURS)

Occurrence, classification and functions of carbohydrates. Monosaccharide : Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Inter conversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;

Structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding

their structure elucidation. Colour tests for carbohydrates

UNIT II -CARBOXYLIC ACIDS (7 HOURS)

Carboxylic acids - Nomenclature - Preparation and reactions of acrylic and crotonic acids. Preparation and reactions of Hydroxy acids - lactic acid, tartaric acid and citric acid.
Dicarboxylic acids - Preparation and reactions of malonic, succinic, maleic and fumaric acids - Blanc's rule. Preparation and reactions Aromatic acids - Benzoic acid, Pthalicacids, anthranilic acid, salicylic acid, cinnamic acid

UNIT III - NITROGEN CONTAINING COMPOUNDS- (9 HOURS)

Nitro compounds – Nomenclature , General methods of preparation- (From alkane, alkyl halides,and halogeno carboxylic acid) . Preparation of Nitro benzene, Reduction, Electrophylic substitution, Nucleophylic substitution.

Cyanides and isocyanides- Nomenclature - General methods of preparation.

Amines –Preparation – From Alkyl halide, Nitro Compounds, Nitriles, Hoffman Bromamide reaction, Curtius reaction, Schmidth reaction, reduction of Alkyl isocyanide, Preparation of tertiary amine.

Chemical reaction- Acylation, Benzoylation, Diazotisation, Reactions of diazoniumsalt, Carbyl amine reaction, Hoffman's exhaustive methylation , Hoffman's elimination ,Mannich reaction, Ring substitution, Separation of mixture by Hinsberg method , Hoffmans tests for amine.

UNIT IV AMINO ACIDS, PROTEINS AND NUCLIC ACIDS (12 HOURS)

Classification of amino acids-α-Amino Acids - Synthesis - Gabriel, Strecker and Erlemeyer synthesis, ionic properties and reactions. Zwitterions, pK_a values, isoelectric point and electrophoresis;

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.
Determination of Primary structure of Peptides by degradation - Edman degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by *N*-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis. Denaturation of proteins.

Components of nucleic acids, Nucleosides and nucleotides;

Structure of: Adenine, Guanine, Cytosine, Uracil and Thymine;. synthesis of Adenine and thymine . Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

UNIT V INTRODUCTION TO NATURAL PRODUCTS (6 HOURS)

Alkaloids- Introduction- Properties and structure of Coniine, Nicotine and Quinine- Structural elucidation of Nicotine. Medicinal importance of Nicotine, Quinine, Morphine, Cocaine, and Reserpine.

Steroids- General characteristics and structure of cholesterol, Testosterone and Oestrone.

Vitamin- Water soluble and fat soluble vitamins . Synthesis of Vitamin C

Terpenes- Definition- Isoprene rule- Occurrence, isolation and structural elucidation of Citral

- natural rubber

Lipids : Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number.

UNIT VI HETEROCYCLIC COMPOUNDS (7 HOURS)

Classification and nomenclature, Structure and aromaticity in 5-numbered and 6-membered rings containing one heteroatom - Peparation, properties and structure of the following compounds- Pyrrole, Pyridine, Indole, Quinoline, Isoquinoline - Relative basic character of Pyrrole, pyridine and piperidine- Hofmann's exhaustive methylation of piperidine.

UNIT VII - PHARMACEUTICALCOMPOUNDS:(7HOURS)

Classification of drugs - Antibiotics- Discovery and importance, mode of action and examples- Misuse of antibiotics- antibacterial and antifungal agents- Sulpha drugs-mode of action-Importance-Examples and uses. Synthesis of Sulphacetamide. Antipyretics & analgesic and anti inflammatory agents - Mode of action. Narcotic and non narcotic analgesic, examples and uses. Synthesis of Paracetamol and Aspirin -Anti histamine-example. CNS Drugs – Synthesis of Phenobarbital , Psychoactive drugs – Hallucinogens, tranquillizers, Examples.

UNIT VIII PHOTOCHEMISTRY AND PERICYCLIC REACTIONS (7 HOURS)

Introduction to photochemistry- Photochemical reactions of carbonyl compounds - Norrish type I and II cleavages (Acyclic only)-Photo reduction of ketone

Concerted reactions, Molecular orbitals of ethene, 1,3-butadiene and allyl radical. Symmetry properties, HOMO, LUMO, Thermal and photochemical pericyclic reactions. Types of pericyclic reactions – electrocyclic, cycloaddition and sigmatropic reactions – one example each and their explanation by FMO theory.

UNIT IX GREEN CHEMISTRY (5 HOURS)

Need for Green chemistry - Goals of green chemistry - Limitations.

Twelve principles of green chemistry with their explanations and examples - Designing a green synthesis - Prevention of waste / byproducts - Atom economy (maximum incorporation of materials used in the process) - Minimization of hazardous / toxic products. Green synthesis - Microwave assisted reactions in water - Hoffann Elimination - Microwave assisted reaction in organic solvent - Diels Alder reaction, Ultrasound assisted reaction -Esterification, Saponification. Green chemistry in day to day life.

References

1. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', Visal Publishing Company Co.

2. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', Vikas Publishing House

3. B. S. Bahl 'Advanced organic Chemistry', S. Chand.

4. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', Pearson Education.

5. I. L. Finar Organic Chemistry, Vol.- II, Pearson Education

6. M.S.Yadav, 'Synthetic drugs'

7. V.K. Ahluwalia, M. Kidwai 'New trends in Green Chemistry', Anamaya Publishers.

8. V. Kumar, 'Introduction to Green Chemistry', Vishal Publishing House. Further Reading

Further reading

1. P. Y. Bruice, 'Organic Chemistry', Pearson Education.

2. J. March, 'Advanced Organic Chemistry', John Wiley & Sons, NY

3. S. H. Pine 'Organic Chemistry', McGraw Hill

4. J. Clayden, N. Greeves, S. Warren and P. Wothers, 'Organic Chemistry', Oxford University Press

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks	Unit	Marks
I	10	IV	10	VII	6
II	6	V	5	VIII	8
III	8	VI	5	IX	4

Type of questions & Marks for External Examination -

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Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSEXV: PHYSICAL CHEMISTRY - III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B15PCH/CHE	4	3	3

Course outcome

On successful completion of this course, students should be able to

CO 1) Understand the mechanism of electrical conductance, theories of electrical conductance, and coductometric titrations

2) Understand the basic principle of ionic equilibrium and its application in laboratories

3) Design different types of electro chemical cell and able to calculate its potential.

4) Familiarise with electro analytical methods

5) Acquaint with kinetics of simple, complex, enzymatic and surface reactions

6) Understand basic principles of photochemistry and its application in spectro photometry

Credit- 3 Contact hours -72

UNIT 1 Electrical Conductance (16 hrs)

Mechanism of electrical conduction – Arrhenius theory – The laws of electrolysis – Faraday's law and its significance – Transference Number – True and apparent transport numbers-Determination by Hittorf's method and moving boundary method. Equivalent conductance and Molar conductance -Effect of Dilution on conductance – Effect of dielectric constants of solvents – Ionic mobilities – Kohlrausch's Law – applications – Mobilities of Hydrogen and Hydroxyl ions – Diffusion and ionic mobility. Activity and activity coefficient – standard state ionic activities and activity coefficient – ionic strength – Debye – Huckel Theory – Ionic atmosphere – Debye – Huckel limiting law – Temperature dependence of ionic conductance-Debye-Falkenhagen effect-wein effect(definition only)- determination of solubilities by conductance measurements – conductometric titrations – conductance in non-aqueous solvents.

UNIT 2 Ionic Equilibria (10 hrs)

Ionic product of water – Dissociation constants of acids and bases – pH and its determination – Heat of neutralization – Incomplete neutralization – Hydrolysis of different types of salts – Degree of hydrolysis and hydrolytic constant – and its relation with pH and pOH – Buffer solution – pH of Buffer solution – Henderson's equation – Buffer capacity – Application of buffer – Preparation of a buffer(one example)-

Acid – base indicators –Theory of acid – base indicators.

UNIT 3 Electromotive Force (23 hrs)

Electrochemical cell-Daniell cell – Reversible and Irreversible cell – Single electrode potential – EMF of cells – Standard potential and standard emf – Standard Hydrogen electrode and calomel electrode – Types of electrodes – electrode reaction – cell reaction -Nernst equation for electrode potential and emf of the cell – Electrochemical series – IUPAC sign convention – Application of Gibb's Helmholtz equation to galvanic cells – Calculation of ΔG, ΔH, ΔS and equilibrium constant from emf data – The standard cells – Weston Cadmium cell and its emf. Concentration cells – Electrode and electrolytic concentration cells with and without transference and their emfs – Liquid junction potential – Elimination of liquid junction potential – salt bridge – application of potential measurements – Determination of solubility product, ionic product of water, transport number . pH determination – Hydrogen, Quinhydrone electrode and glass electrode –advantages and dis advantages.potentiometric titration – redox indicators — Fuel cells. (hydogen-oxygen, hydrocarbon-oxygen)

Polarography : Dropping Mercury Electrode, Polarization – Concentration polarization, Half wave Potential and Diffusion current (Significance), Ilkovic equation, Advantages of polarographic analysis – Applications.

UNIT 4 Chemical Kinetics (15 hrs)

The rates of chemical reactions – Experimental techniques – rate laws and rate constant – Order and molecularity of reactions – Methods of determining the order of reaction – Integrated rate laws of zero order, first order and second order reactions — General integrated rate equation for nth order reaction - Zero and fractional order reactions - Half life –types of complex reactions-consecutive parallel and opposing reactions-Derivation of parallel and opposing reactions. Temperature dependence of reaction rates – Arrhenius equation – Interpretation of parameters – steady state approximation – Kinetics of unimolecular reactions –Lindemann's theory. Theories of reaction rates – collision theory – Derivation of rate equation for second order reaction from collision theory – thermodynamic approach of transition state theory – Entropy activation. Catalysis – Homogeneous and Heterogeneous catalysis – examples – Features of homogeneous catalysis – Enzymes – Michalis – menten mechanism. Heterogenous catalysis – Kinetics of unimolecular surface reactions– Langmuir isotherm– 2nd order surface reactions-Hinshelwood mechanism .

UNIT 5 Photo Chemistry (8hrs)

Photochemistry – consequences of light absorption – The Jablonski diagrams – Radiative and non radiative transition – Light absorption by solutions – Lambert – Beer Law – Laws of photochemistry – The Grotthus – Draper law – Stark – Einstein law – Quantum efficiency / Quantum yield – Experimental determination of quantum yield – High and low quantum yield -Photochemical rate law – Energy transfer in photochemical reactions – Photo sensitization-application in photosynthesis(brief idea only) - quenching – Chemiluminescence – Lasers.

Colorimetry and Spectrophotometry : Instrumentation of photocolorimeter and spectrophotometer-block diagrams with description of components.

References

1. Physical Chemistry : P.W. Atkins, Oxford University Press.
2. Physical Chemistry : Puri, Sharma and Pathania, Vishal Publishing Co.
3. A Text book of Physical Chemistry: A S Negi and S C Anand, New Age International Publishers.
4. A Textbook of Physical chemistry: K. L. Kapoor, Volumes 1 &5, Macmillan India Ltd
5. Advanced Physical Chemistry: Gurdeep Raj, Goel Publishing House, Meerut.
6. Physical Chemistry: W.J. Moore, Orient Longmans.
7. Physical Chemistry: N. Kundu & S.K. Jain, S.Chand & Company.
8. Physical Chemistry : K. J. Laidler, John H.Meiser,
9. Chemical Kinetics : K.J.Laidler, Pearson Education.
10. Physical Chemistry : P C Rakshit
11. Electrochemistry: Samuel Glasstone

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks
I	14	IV	14
II	8	V	6
III	20		

Table 8. Type of questions & Marks for External Examination -

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	24	17		40

Question papers in Physical Chemistry course should contain numerical problems for 20% of the total marks.

CORE COURSEXVI: PHYSICAL METHODS IN CHEMISTRY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B16PCH/CHE	3	3	3

Course outcome

On successful completion of this course, students should be able to

CO 1 i) Explain the important principles of spectroscopy
ii) Apply spectroscopic techniques in analyzing the structure of simple organic molecules

CO 2 Acquainting the working principles of various instruments and their functions

CO 3 Understand the basic principles of symmetry and group theory and its applications in chemistry

CO 4 Study the basic principles of nanochemistry and understand the various nanofabrication methods

CO 5 Explain the important principles for quantum chemical and molecular mechanic methods of computing the geometry and energy of molecules

Contact hours-54

UNIT 1 Spectroscopy I (18 Hours)

Introduction: electromagnetic radiation, regions of the spectrum, interaction of electromagnetic radiation with molecules, Born-Oppenheimer approximation.

Microwave Spectroscopy – Rotation spectra-Instrumentation- Moment of inertia, Rotational Quantum numbers, Rotational Constant, Intensities of rotational spectral lines, Rotational – Vibrational Spectrum of diatomic molecules – Selection rules for rotational spectra.

Infrared Spectroscopy –Theory of infrared spectra-Degree of freedom in poly atomic molecules, Selection rule, Molecular vibration – Stretching and Bending modes, Calculation of stretching frequencies – fundamental Bands and Overtones, hot bands and Fermi resonance. Factors influencing vibrational frequency – Electronic effects, hydrogen bonding, solvent effect . Applications of IR Spectroscopy .

Raman Spectroscopy –block diagram, quantum theory of Raman scattering- Stokes and antistokes lines-selection rule, rule of mutual exclusion

UNIT 2 SPECTROSCOPY II (18 Hrs)

.

UV Spectroscopy –

Franck condon principle-intensity of spectral lines -Absorption laws, Selection Rules – Types, Electronic transitions – Position and Intensity of absorption, Molar extinction coefficient, Chromophore – Auxochrome Concept, Absorption and Intensity Shifts, Types of Absorption Bands, Interpretations of spectra of simple conjugated dienes and enons, Woodward-Fieser Rule, Application to dienes and enons.

NMR Spectroscopy –- Introduction, Theory of NMR, Phenomena of resonance, Modes of nuclear spin-Relaxation Process, Chemical Shift – Internal standard, δand τ scale, Shielding Effects, Factors affecting Chemical Shift, Spin-Spin interaction, Interpretations of spectra of ethylbromide, ethanol, acetaldehyde, acetone, toluene and acetophenone.
Mass Spectrometry – Basic principles,, Fragmentation pathway, Molecular ion peak, base peak, Meta stable ion, General rules for predicting the prominent peaks, Mc Lafferty Rearrangement, mass spectra of alkanes, cyclo alkanes, saturated alcohols and aliphatic ketones.

UNIT 4 Molecular Symmetry and Group Theory (6 hrs)
Symmetry of molecules-symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, Identity – proper axis of rotation, improper axis of rotation – Schonflies notation – Point groups of simple molecules – Cnv, Cnh,H2O,NH3,N2O4,N2F2.

UNIT 5 Concepts and Applications of Nano Science (7 hours)
Introduction - Nanomaterials – Classification based on dimensions, Synthesis – Top down and Bottom up-chemical precipitation, mechano-chemical method, micro emulsion method, reduction technique, chemical vapour deposition and solgel method, Hydrothermal synthesis(brief study)- Important methods for the characterization of nanomaterials – Scanning electron microscopy (SEM), transmission electron microscopy (TEM). Synthesis and applications of Quantum dots, Carbon nanotubes and Graphene (brief study).

UNIT 6 Introduction to Computational chemistry (5 hrs)
Molecular mechanics and force fields, Electron structure theory methods, Ab-initio methods and Basis Sets, Hartree-Fock Theory, Semiempirical Methods, Electron Correlations, Density Functional Theory, Gaussian input file format, Z-matrix

References
1. Physical Chemistry – A molecular Approach: Mc Quarrie, J. D. Simon, Viva Books Pvt Ltd.
2. Fundamentals of molecular spectroscopy: C. N. Baanwell and E M Mc Cash, TataMc GrawHill
3. A Textbook of Physical chemistry: K. L. Kapoor, Volume 4, Macmillan India Ltd.
4. Physical Chemistry, I. N. Levine, Tata Mc Graw Hill.
5. Elements of Physical chemistry: Puri, Sharma and Pathania, Vishal Publishing Co.
6. Physical Chemistry, K. J. Laidler, John H.Meiser.
7. Physical Chemistry : P.W. Atkins, Oxford University Press.
8. Electronic absorption spectroscopy and related techniques: D. N. Satyanarayana, Universities Press.
9. Nanosciece and nanotechnology: V. S. Muraleedharan and A. Subramania, Ane Books Pvt. Ltd.
10. Nano; The Essentials: T. Pradeep, Mc Graw-Hill education. 11 Symmetry and spectroscopy of molecules: K.Veera Reddy, New Age.International(P) Ltd
11. F. Jensen, Introduction to Computational Chemistry, (Wiley, New York, 1999). Good introductory textbook covering a variety of topics.
12. A. Szabo and N. S. Ostlund, Modern Quantum Chemistry, Introduction to Advanced Electronic Structure Theory, 1st ed., revised (Dover, 1989). More mathematical detail for many of the ab initio electronic structure methods.
13. D. A. McQuarrie, Quantum Chemistry (University Science Books, Mill Valley, CA, 1983). Very readable introductory text for undergraduate-level quantum chemistry.
14. I. N. Levine, Quantum Chemistry, 4th ed. (Prentice Hall, Englewood Cliffs, NJ, 1991). Covers some

of the topics in this course.

15.Errol Lewards-computational chemistry-Introduction to theory and applications of molecular and quantum mechanics.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks
I	20	V	6
II	20		
III	7		
IV	9		

Table 8. Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

Question papers in Physical Chemistry course should contain numerical problems for 20% of the total marks.

CORE COURSE XVII: ENVIRONMENTAL CHEMISTRY

(DISCIPLINE SPECIFIC ELECTIVE COURSE)

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B17PCH/CHE- A	3	3	3

Course Outcome

On successful completion of this course, students should be able to

CO1 Know the importance of environmental studies and methods of conservation of natural resources.
CO2 Describe the structure and function of an ecosystem and explain the values and Conservation of bio-diversity.

CO3 Explain the sources, environmental effects and control measures of various types of pollutions.

CO 4: Identify the toxic chemicals in environment and understand the sources, effects and treatmentof heavy metal poisoning

CO5: Understand the methods of domestic water treatment , Sewage analysis and Sewage treatment

Contact hours 54

Unit I . Environmental segments (6 hours)

Environmental segments: Lithosphere, Hydroshere, Atmosphere and Biosphere.

Atmospheric structure and composition - chemical composition of water in water bodies – (Ground water, river water and lake water, sea water wetlands)- Hydrological cycle.

Chemical Toxicology – Toxic chemicals in environment – Sources, effects and treatment

of heavy metal poisoning – Pb, As, Cd, Hg, Cr, Cu & Co. Minamata and Itai-Itai

diseases.

Unit II. Air Pollution (14 hours)

Pollutant-classification

Air pollution – Air pollutants –CO, NOx, SO2, H2S, Hydrocarbons, particulate matter.

Acid rain and its effects.

Green house effect and global warming – climate change – ozone chemistry and ozone

hole- chlorofluorocarbons, dioxins. Photochemical smog (reactions) – El Nino

phenomenon.Bhopal gas tragedy.Control of air pollution – control by devices – Stacks, filters, electrostatic precipitators, cyclone separators, scrubbers and catalytic converters.

Unit III. Water pollution (12 hours)

Water resourses, - water pollution – sources – Industrial effluents – agriculture discharge- oil spills – heavy metals – pesticides – detergents

Eutrophication – biomagnifications and bioaccumulation – experimental determination of Dissolved oxygen, BOD and COD – Thermal Pollution – Control of water pollution –ISI/BSI standards of drinking water. Hardness of water – causes and effects – methods of estimation – removal of hardness. Domestic water treatment – Sewage – Sewage analysis -Sewage treatment

Unit IV. Soil Pollution (11 hours)

Lithosphere – soil formation-Different types of weathering – components of soils – Acid Base and ion exchange reactions in soil – soil pollution – soil acidification – effects on plants – liming of soil – Industrial and urban wastes – plastics, pesticides and heavy metals in soil – garbage –biomedical waste – E waste –Municipal Solid waste management. Bioremediation

Unit V. Noise and Radiation pollution (11 hours)

Noise pollution and Radioactive Pollution : Human acoustics - Noise – general features - types of Noise – Measurement of noise – sound pressure and power levels – sources and effects of noise pollution – prevention of hearing loss in industry – control of noise pollution.

Radiation chemistry – Man made and natural radiations – biological effects of radiation - radiation hazards from reactors –Fukushima nuclear disaster- radioactive wastemanagement

References:-

1. Environmental Chemistry, A.K.De.
2. Environmental Chemistry, P.S. Sindhu
3. Environmental Chemistry, B. K. Sharma
4. Essentials of environmental studies, S.P. Misra & S.N.Pandey
5. Advanced Inorganic Chemistry Vil. II , Gurdeep Raj
6. Engineering Chemistry , Dr. B.K. Sharma

7. Engineering Chemistry, Jain & Jain, Dhanpat Rai Publishing Company

8. A Basic course in environmental studies, Surinder Deswal & Anupama Deswal.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks
I	6	V	12
II	16		
III	14		
IV	14		

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSE XVII: APPLIED CHEMISTRY

(DISCIPLINE SPECIFIC ELECTIVE COURSE)

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B17PCH/CHE- B	3	3	3

Course Outcomes :

On successful completion of this course, students should be able to

CO-1Explain the origin of coal,coal products ,petroleum products and their applications.

CO-2 Explain the manufacture of fertilizers , pesticides and their applications

CO-3 Understand the manufacture of glasses, cement ,ceramics and the formulations of paints and varnishes

CO-4 Familiarize with the chemistry of fats and oils and explain the production of soaps and detergents.

CO-5 Understand the chemistry of food additives and explain the manufacture and refining of pulp.

CO-6 Understand importance of industrial safety and industrial pollution control.

Hours:54

UNIT 1: Fuel chemistry (10 hrs)

Coal: Origin of coal, carbonization of coal, coal gas, producer gas, water gas, coal based chemicals.

Petroleum and Petrochemical Industry**:** Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels.

Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives.

UNIT 2: Agrochemistry (9 hrs)

Fertilizers: Classification of fertilizers, Manufacture of ammonium salts like ammonium nitrate, ammonium sulphate and urea. Action of Ammonium sulphate and urea as fertilizers.N.P.K. Fertilizers and Natural organic fertilizers.

Pesticides:Production and applications and residual toxicity of organochlorine pesticides (DDT, Aldrin), organophosphates (parathion, malathion), Carbamate (carbofuran). Bio-pesticides

UNIT 3: Silicate Industry (8hrs)

Glasses: Classification and manufacture of glasses, Annealing of glass. Fiber glass, coloured glass, and optical glass

Cement: Portland cement - types, manufacture, composition and setting of cement.

White cement and water proof cement.

Ceramic: Subdivisions- raw materials - manufacturing-applications.

UNIT 4: Paints, Lubricants, Adhesives and Pigments (10 hrs)Paints: Classification**,** primary constituents and manufacturing of a paint. Emulsion paint - constituents and advantages.Latex paints and fire retardant paints. Solvents and thinners.

Lubricants: Properties and classification, additives for lubricating oil, lubricants of mineral origin, lubricating grease and solid lubricants.

Adhesives: The Process of bonding. Classification and preparation of adhesives, synthetic resin adhesives, and rubber based adhesives, uses of adhesives.

Pigments: Characteristics and uses of titanium dioxide, ultra marine blue and red lead

UNIT 5: Food Chemistry (8 hrs)

Food additives:Food flavour, food colour, food preservatives, artificial sweeteners, edible emulsifiers and edible foaming agents- uses and abuses of these substances in food and beverages

Fermentation Chemicals: Production, and purification of ethyl alcohol, citric acid, lactic acid, Vitamin B12, Penicillin.

UNIT 6: Chemical Explosives. Industrial safety and pollution prevention (9 hrs)

Chemical explosives: Characteristic of explosives, preparation and explosive properties of Trinitro toluene, Lead azide , Nitroglycerine, RDX.

Industrial safety: OSHA-Hazard analysis and risk assesment-types of hazards in industries_risk management plan.

Industrial pollution prevention: Definition of industrial waste-types of industrial waste-Industrial pollution prevention-Recycling-waste treatment.

REFERENCES

1. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

2. *Industrial chemistry* by B.K Sharma.

3. Industrial chemistry B.N Chakrabarthy

4. Stocchi: *Industrial Chemistry*, Vol-I, , Ellis Horwood Ltd. UK

5. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi

6. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.

7. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.

8. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi

9. Carey, D.E. Casida*Industrial Microbiology.*

10. *Mechanism and theory in food chemistry,* Dominic W.S.Wong

11. *Food Science* , R. Sreelakshmi

12. Mohammad Farhat Ali, Bassam M. El Ali,, James G Speight, *Hand book of Industrial chemistry: Organic Chemicals,* Publisher: Mc-graw Hill Education

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks	Unit	Marks
I	12	V	8
II	12	VI	10
III	10		
IV	10		

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSE XVII: POLYMER CHEMISTRY

(DISCIPLINE SPECIFIC ELECTIVE COURSE)

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B17PCH/CHE- C	3	3	3

Course Outcome

On successful completion of this course, students should be able to

CO 1) Classify polymers and explain the configuration of polymers and properties like glass

transition temperature and melting point of polymers

CO3) Illustrate the preparation, properties and applications of polymers

CO4) Interpret the mechanism of polymerization

CO5) Acquaint various polymer processing technologies and explain thermal methods of analysis of polymers

CO6) Know the recent advances in polymer chemistry

Contact Hrs : 54

1. Introduction. (16 hours)

Definition of monomer, polymer and polymerization – Classification of polymers - natural, semisynthetic and synthetic - condensation & addition polymers - Linear, branched and crosslinked polymers - Homo polymers and copolymers – Graft and block copolymers, composites, blends, elastomers, fibres, plastics, thermoplastic and thermosetting polymers. Tacticity in polymers-Isotactic, syndiotactic and atactic polymers. Properties of polymers : Glass transition temperature (Tg) - Definition- Factors affecting Tg - relationships between Tg and molecular weight and melting point. Importance of Tg.

2. Plastics, rubbers and fibres. (14 hours)

Preparation, properties and applications of - Plastics: Polyethylene, Polyvinylchloride, polymethyl methacrylate, polyethylene terphthatalate, Teflon, Bakelite. Rubbers: natural and synthetic rubbers – polybutadiene, polyisobutylene, butyl rubber, nitrile rubber, BUNA-S, BUNA N, neoprene rubber. Synthetic fibres : Nylon 66, Nylon 6, Rayon.

3. Polymerisation Techniques (14 hours)

Types of polymerization- addition (initiation, propagation and termination), condensation, ionic (cationic & anionic), Ring opening polymerizations (epoxy resins) coordination polymerization –

Ziegler Natta catalyst - moulding of plastics into articles- compression moulding - injection moulding - blow moulding - extrusion moulding – Calendering – Spinning.

4. Advances in Polymers (10 hours)

Biopolymers - biodegradable polymers - Polymers in medical field - High temperature and fireresistant polymers - Conducting polymers PAC, PPP, PPY etc - Polymers used as adhesive and coatings, liquid crystalline polymers, Vulcanization of rubber. Environmental Hazards of plastics and recycling

References:

1. V.R. Gowariker, N.V. Viswanathan and Sreedhar, *Polymer Science*, Wiley Easern Ltd.
2. F.W. Billmeyar, *A text book of polymer science*, John Wiley & Sons, 1971.
3. Maurice Morten, *Rubber Technology*, Van Nostrand, Reinold, New York.
4. S. Paul, *Surface Coatings*.
5. B.K. Sharma, *Polymer Chemistry*, Goel Publishing House, Meerut.
6. M. Jenkins, *Biomedical Polymers*, University Birmingham, U.K.
7. M.G. Arora, M. Singh and M.S. Yadav, Polymer Chemistry, 2nd Revised edition, Anmol Publications Private Ltd.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	17
II	15
III	16
IV	14

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

CORE COURSE XVII: NANOCHEMISTRY
(DISCIPLINE SPECIFIC ELECTIVE COURSE)

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B17PCH/CHE- D	3	3	3

Course Outcomes

On successful completion of this course, students should be able to

CO 1: Understand the basic concepts and classification of nanomaterials.

CO 2: Analyze different nano systems and their properties.

CO 3 :Understand the various techniques adopted for the synthesis and characterization of nanomaterials.

CO4 : Characterize the nanomaterials using various microscopic techniques.

CO 5: Understand the application of nanomaterials in various fields including catalysis, photonics, and medicine

Contact hours: 54 Hrs

Unit I Introduction to Nanomaterials (10 hrs)

Nanotechnology- Definition, Historical milestone. Faynmans hypothesis, Surface area to volume ratio, Quantum confinement, Classification of Nanomaterials based on dimesnsions (0D, 1D, 2D, 3D). Different types of nano systems (synthesis and properties)- Carbon nano systems- fullerenes, graphenes, carbon nanotubes; Inorganic nano particles-TiO_2, ZnO; Organic nano systems-dendrimers, Metal nano particles-quantum dots.

Unit II Nanosynthesis (16 hrs)

Various methods for the synthesis of nanoparticles: Top-down and Bottom-up approaches. Physical methods-Ball Milling, Melt mixing techniques, Physical vapour deposition, Chemical vapour deposition (CVD).Chemical methods-Chemical precipitation, Sol gel Method, Hydrothermal and Solvothermal synthesis, Microemulsion or Reverse micelle synthesis. Microwave synthesis, Electrochemical method. Biological synthesis using plant extract and micro organism.Molecular self assembly.

Unit III. Nanomaterial Characterisation (16 hrs)

Important methods for the characterization of nanomaterials –Principles and Applications only-Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning tunneling electron microscopy (STEM), Scanning probe microscopies (SPM)-Scanning tunneling microscopy (STM), Atomic force microscopy (AFM), Photoelectron spectroscopy (UPES and XPES), X-ray diffractometer (XRD). UV-visible and Raman Spectroscopy.

Unit IV Applications of Nanomaterials (12 hrs)

Nanomaterials for environmental Remediation- Photocatalysis, Water purification using nanomaterials, desalination of water, Heavy metal and oil spill removal. Solar energy conversion (Dye sensitized solar cells) and storage (Supercapacitors).Nanocatalyst.Biological applications-Imaging, labeling, targeted drug delivery.Nanomaterials in electronics and spintronics, Nanosensors.Applications in Self cleaning surfaces, sports equipments, and cosmetics.

References:

1. T. Pradeep, Nano: The Essentials, Mc Graw Hill Publishing Company, New Delhi (2007).
2. C. N. R. Rao and A.Govindraj, Nanotubes and Nanowires, Royal Society of Chemistry(2005).
3. V. S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009.
4. Dr.Ashuthosh Sharma,Dr.Bellari, Advances in Nanoscience and Nanotechnology- -CSIR Publication 2004
5. G. A. Ozin et.al, Nanochemistry: A Chemical Approach to Nanomaterials – Royal Society of Chemistry, Cambridge, UK 2005.
6. R. Booker and , E. Boysen, Nanotechnology, Wiley India Pvt Ltd, 2008.
7. K. J. Klabunde, Nanoscale materials in chemistry, John Wiley and Sons.
8. S.M. Lindsay, Introduction to Nanoscience, Oxford University Press.
9. K.K. Chattopadhyay and A. N. banergee, Introduction to nanoscience and Technology, PHI learning pvt. Ltd. Delhi.
10. Sulabha K. Kulkarni, Nanotechnology Principles and Practices, Capital Publishing Company,Kolkatta.
11. http://www.zyvex.com/nanotech/feynman.html
12. https://www.azonano.com/

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	12
II	18
III	17
IV	15

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SYLLABUS OF BSc CHEMISTRY PRACTICAL
SEMESTER III & IV

CORE COURSE PRACTICAL I (3B03PCH/CHE & 4B03PCH/CHE)
Volumetric Analysis

72 hrs/ credit 2

On successful completion of this course, students should be able to

CO 1) Apply the theoretical concepts while performing experiments.

CO2) Acquire practical skill to estimate acid, base, oxidizing agents etc by volumetric titration method

CO3) Estimate the metallic ions by complexometric titration method

CO4) Acknowledge experimental errors and their possible sources.

CO5) Able to prepare inorganic complexes

CO 6) Design, carry out, record and analyze the results of chemical experiments

Introduction to Volumetric analysis

Equivalent and molecular mass of compounds. Normality and Molarity -Primary standards. Preparation of standard solution - Principles of volumetric analysis. For acidimetry, alkalimetry and permanganometry two burette method may be used and for other volumetric analyses conventional methods can be used.

1 Acidimetry And Alkalimetry

a)Estimation of NaOH/KOH using standard Na_2CO_3.

b) Estimation of $HCl/H_2SO_4/HNO_3$ using standard oxalic acid.

2 Permanganometry

a. Estimation of oxalic acid.

b. Estimation of Fe^{2+}

c. Estimation of Nitrite.

3 Dichrometry

a. Estimation of Fe^{2+} -using internal and external indicator

b. Estimation of Fe^{3+} - reduction by SnCl2 - internal indicator

4 Iodometry And Iodimetry

a. Estimation of Cu^{2+} / CuSO4 SH2O.

b. Estimation of potassium dichromate.

c. Estimation of As2O3/As^{3+}

5 Precipitation titration-using adsorption indicators

a. Estimation of chloride in neutral medium

6 Complexometry

b. Estimation of Mg^{2+}, $Zn^{2+}$and hardness of water

Inorganic Preparation

c. Ferrous ammonium sulphate.

d. Potash alum.

e. Tetraammine copper(II) sulphate.

f. Potassium trisoxalato chromate.

Prepare any one sample in the examination and exhibit the product.

SEMESTER III& IV

(3B05PCH/CHE & 4B05PCH/CHE) Inorganic Qualitative Analysis

Credit 2

COURSE OUTCOMES

On successful completion of this course, students should be able to

CO 1) Apply the theoretical concepts while performing experiments.

CO2) Acquire practical skill to analyse the anions and cations qualitatively present in a mixture of inorganic salts

CO 3) Able to design, carry out, record and analyze the results of chemical experiments

CO 4) Learns the effective usage of chemicals

1 Systematic qualitiative analysis of mixtures containing two anions by semi micro method. Study of the reactions of the following anions with a view to their identification, confirmation and procedure for elimination - carbonate, acetate, oxalate, fluoride, bromide, iodide, nitrate, sulphate, borate, phosphate, chromate, arsenate, arsenite. One of the anion should be eliminating radical.

2 Systematic qualitative analysis of mixture containing two cations by semimicro method. The cation mixtures may given as solution.

Study of the reaction of the following ions with a view to their identification and confirmation.

Lead, bismuth, copper, tin, iron, aluminum, zinc, manganese, cobalt, nickel, barium, strontium, calcium, magnesium, NH_{4+}

Note : minimum ten mixtures should be analyzed and recorded.

SEMESTER V& VI

5B11PCH/CHE & 6B11PCH/CHE : GRAVIMETRIC ANALYSIS

Credit:3

COURSE OUTCOMES

On successful completion of this course, students should be able to

CO1: Make use of standardised procedures for the Gravimetric analysis

CO2: learn the skills of Precipitation process, digestion, filtration, incineration etc.

CO3:Aquire practical Knowledge of co-precipitation

CO4: Handle sintered glass vessels

CO5) Acknowledge experimental errors and their possible sources.

CO6Able to design, carry out, record and analyze the results of chemical experiments

Introduction to gravimetric techniques and its highlights.

1. Determination of water of hydration in crystalline barium Chloride.
2. Determination of barium as barium sulphate.
3. Determination of sulphate as barium sulphate.
4. Determination of iron as ferric oxide.
5. Determination of calcium as calcium carbonate.
6. Estimation of nickel as nickel dimethylglyoxime.
7. Determination of copper as cuprous thiocyanate.
8. Determination of magnesium as magnesium oxinate.

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SEMESTER V& VI

5B12 PCH/CHE & 6B12PCH/ CHE : ORGANIC CHEMISTRY

Credit:3

COURSE OUTCOMES

On successful completion of this course, students should be able to

CO 1) Apply the theoretical concepts while performing experiments.

CO2) Acquire practical skill in qualitative analysis of organic compounds

CO 3) Acquire practical skill in preparing organic compounds and in their purification by crystallisation

CO4) Separate organic compounds in a mixture –by steam distillation, TLC and Column Chromatography

CO5) Acquire the habit of working safely with the chemicals and handling of equipments

1. Synthesis of Organic Compounds.

a. Aromatic electrophilic substitution:

Nitration

Preparation of dinitrobenzene from nitrobenzene. Preparation of p-nitroacetanilide

Halogenation -

Preparation of *p*-bromoacetanilide.

preparation of 2, 4, 6 - tribromophenol.

b. Diazotization and coupling :

Preparation of phenyl azo β-naphthol. Preparation of methyl orange.

c.Oxidation :

Preparation of benzoic acid from benzyl chloride or benzaldehyde

d.Esterification :

Benzoylation of phenol/aniline to phenyl benzoate.

e. Hydrolysis : Benzamide or ethylbenzoate to benzoic acid.

2.Organic Qualitative Analysis

a. Qualitative analyses with a view to characterize functional group/groups in the following compounds:

Naphthalene, anthracene, chlorobenzene, bromobenzene, benzyl chloride, *p*-

dichlorobenzene, benzyl alcohol, phenol, cresols, naphthols, resorcinol, benzaldehyde, acetophenone, benzophenone, benzoic acid, phthalic acid, cinnamic acid, succinic acid, salicylic acid, ethyl benzoate, methyl salicylate, benzamide, urea, aniline, toludines, dimethyl aniline, nitrobenzene, *o*-nitrotoluene, glucose, sucrose.

b. Preparation of derivatives.

Note : Minimum ten compounds should be analyzed and recorded. For analysis, reactions may be carried out in tiles, wherever possible.

3. Thin layer Chromatography and Column Chromatography

a. Preparation of the TLC plates - Checking the purity of the compounds by TLC - Acetylation of salicylic acid, aniline, Benzoylation of aniline and phenol, Determination of Rf. Values and identification of organic compounds by TLC, preparation and separation of 2, 4 -dinitrophenyl hydrazones of acetone and 2- butanone using toluene and light petroleum (40 :60).

b. Separation of ortho and para nitroaniline mixture by column chromatography.

4. Demonstration Experiments Steam distillation : Separation of ortho and para nitro phenols.

SEMESTER VI

6B18PCH/CHE `PHYSICAL CHEMISTRY

CREDIT: 3

Hrs/week: 5

COURSE OUTCOMES

On successful completion of this course, students should be able to

CO 1) Acquire practical skill in physical chemistry experiments such as Cryoscopy, Transition Experiments ,Phase Rule Experiments, Conductometric titrations ,Potentiometric titrations , colorimetry and Chemical Kinetics

CO2) Learn statistical approach for evaluating data

CO3) Able to carry out and record these experiments in a skilful manner

CO4) Acquire the habit of working safely with the chemicals and handling of equipments

1: Cryoscopy Using Solid Solvent

a) Cryoscopic constant of solid solvent using a solute of known molar mass (cooling curve method)

Solid solvents/solutes given: Naphthalene, Biphenyl, diphenyl amine.

b)Molar mass of the given solute, using solvent of known K_f.

Solid solvents/solutes given: Naphthalene, Biphenyl, diphenyl amine. 2: Transition Experiments (cooling curve method)

a) Transition point, depression constant (KT) of the given Salt hydrate, using solute of known molar mass.

salthydrates: $Na_2S_2O_3.5H_2O$./ $CH_3COONa.3H_2O$. Solutes : Urea, Glucose,

b) Molar mass determination of given solute using salt hydrates of known

(KT) Salt hydrates and solutes as above

3: Phase Rule Experiments

Critical Solution Temperature (C.S.T)

a) Critical solution temperature of phenol - water system

b) Concentration (% composition) of NaCl/KCl by C.S.T Measurements

4. Conductometry

Conductometric titrations

a) Strong acid x strong base

b) Weak acid x strong base

5 : Potentiometry

Potentiometric titrations

a) Acid base titration (Strong acid, strong base)

6 : Distribution Law

Partition coefficient of I_2 between CCl_4 and H_2O

7. colorimetry

Verification of Beer-Lambert law for KMnO4, determination of the concentration of the given solution.

8. Chemical Kinetics - Hydrolysis of methyl acetate using HCl acid.

Note:

1. A minimum number of 8experiment should be done

2. Electronic balance may be used for practical work.

VIVA VOCE

Viva voce examination based on practical will be conducted along with every practical examination.

REFERENCES

1. A.I.Vogel - A Text Book of Qualitat ive Analysis including semi-micro methods

2. V.V.Ramanujan - Semi micro Qualitat ive Analysis.

3. A.I.Vogel - A Text Book of Quantitative Inorganic Analysis.

4. A.I.Vogel - Elementary Pract ical Organic Chemistry.

5. A.O.Thomas - Practical Chemistr y for B.Sc Chemistry.

6. A Findlay - Practical Physical Chemistr y.

7. R.C.Das & E Behara - Experimental Physical Chemistr y.

8. N.K.Vishnoi - Advanced Practical Chemistry.

9. Y.B. Yadav, Practical Physical Chemistry.

STUDY TOUR

Students are required to visit at least one Laboratory/factory/Research Institute of eminence during the course and submit the Study tour report separately along with practical records at the time of practical Exam (6^{th} Semester).

PROJECT REPORT:

PROJECT CO 1) Able to enhance the skills of managing the resources, time and team work.

2) Students will be able to function as a member of an interdisciplinary problem solving team.

Students should undertake a group project work related to Polymer chemistry / Chemistry and submit the report along with practical records during VI semester practical. (Guide lines for evaluation given in Annexure I)

General Guidelines of Project Work

1. Students should undertake the project work related to Chemistry only.
2. The UG level project work is a group activity, maximum number of students being limited to five. However each student should prepare and submit the project report separate
3. The matter should be typed on A-4 size paper with Times New Roman font of size 12 points, with double spacing between the lines and margins of 1.5' at the left, 1' at the right, 1' each at the top and bottom.
4. The report should be printed in plain white paper in black ink only. Color inks for charts and graphs can be used, provided it does not hamper the readability. The logo of the college can be displayed in the report.
5. The project report should be hard bound/ spiral bound / paper back.

Format of Project Report

Title

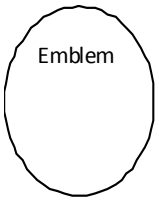
Name of the student

Department

College

Month & Year

Title



Project report submitted to Kannur University in partial fulfillment for the BSc degree (Polymer Chemistry)

By

Name of Student

Reg No

Name & Designation of project guide

Signature, Name & Designation of Head of the department

Examiners:

1)

2)

MODEL QUESTION PAPERS FOR PRACTICALS

B.Sc CHEMISTRY PRACTICAL EXAMINATION
SEMESTER 1I1 & IV- 3B03PCH/CHE & 4B03PCH/CHE

Volumetric Analysis

Time : 3 Hours Maximum marks:40

Credit : 3

Instruction : candidate should submit bonafide record at the time of examination

1. Write down the Principle for the estimation of ……..given …….
2. Calculate the weight of …….. required for the preparation of ……N,……ml solution.
3. Estimate the amount of …….. in the whole of the given solution provided with ……solution and ……cr ystals.
4. Prepare the Inorganic complex…… Recrystallize and exhibit both crude and recrystallized samp les.
5. Viva Voce

SEMESTER IV 3B05PCH/CHE & 4B05PCH/CHE

PRACTICAL II : INORGANIC QUALITATIVE ANALYSIS

Time:4Hours Maximum Marks:40

Credit: 3

Instruction : candidate should submit bonafide record at the time of examination

1. Analyse systematically the given mixture containing the anions and cations by semi-micro method.
2. Viva Voce.

SEMESTER VI 5B11PCH/CHE & 6B11PCH/CHE

PRACTICAL III : *GRAVIMETRIC ANALYSIS

Time : 3 Hours Maximum Marks:40

Credit: 3

1 Write a brief outline of the procedure for the gravimetric estimation of …… ……..in the solution……

2 Estimate gravimetrically the amount of ……..in the whole of the given……. Solution.

3 Viva Voce

SEMESTER VI 5B12PCH/CHE & 6B12PCH/CHE
PRACTICAL IV:*ORGANICCHEMISTRY

Time : 3 Hours Maximum Marks:40

Credit: 3

1. Write down the procedure for the preparation of……..from……..
2. Analyse systematically the given organic compound with a view to identify the funct ional group present in it and submit a report of the procedure adopted. Suggest a suitable solid derivat ive for the compound and write the procedure for its preparation..
3. Convert the given …….into…….Recr ystalise and exhibit both crude and recrystallised samples.
4. Viva Voce.

*Practical paper III & paper IV are to be conducted in the sixth semester for 6hrs on the second day.

SEMESTER VI

PRACTICAL V : 6B18PCH/CHE PHYSICAL CHEMISTRY

Time : 4 Hours

Credit : 3

Instruction : Candidate should submit bonafide record at the time of examinat ion.

Attempt the question marked X

1. Determine the moleculr mass of the given solute B by cryoscopic method. K_f of solid solvent A is ----------. Conduct a duplicate experiment.

2. Determine the rate constant for the hydrolysis of the given ester in the presence of the given acid. Calculate 5 k values. Obtain k value graphically.

3. Determine the Cryoscopic constant of the given solid solvent A using solute B of

molecular mass----------. Conduct a duplicate experiment.

4.Determine the mass of HCl in the given solution conductometrically.

5.Write down the procedure for the experiment marked X within first 5 minutes. 6. Submit the Project Report & Report of Industrial visit.

7.VIVA VOCE

GENERIC ELECTIVE COURSE

CHEMISTRY IN SERVICE TO MAN

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D01PCH/CHE	2	2	2

Contact hours:36Hrs

Course Outcome

On successful completion of this course, students should be able to

CO1) i) Understandthe classification, structure, function and applications of polymers

ii) Understand the importance of biodegradable polymers

CO2) Acquaint with different types of fertilizers and pesticides and understand the effect of fertilizers and pesticides on the environment

CO 3) Explain the classification of fuels and composition of petroleum and familiarise the fuel cells and batteries and Understand their applications in modern life

CO 4) Explain different types of glasses ,their applications and the composition of Portland cement

CO5) Identify the harmful chemicals present in cosmetics and understand their effects in human body

Unit 1. PLASTICS & POLYMERS(10hrs)

Polymers- Types of polymers natural & synthetic polymers-characteristics and examples.

General characteristics and applications of polymers such as Polythene (LDPE &HDPE), polypropylene, PVC, Poly styrene. Artificial fibers -examples

Plastics- Thermoplastics and thermosetting plastics- Characteristics and examples..

Elastomers Natural and synthetic rubbers-Vulcanization(mention only. Biodegradable polymers .examples.

benefits of biodegradable plastics. Importance of plastic recycling.

Unit 2. FERTILIZERS &INSECTICIDES (7hrs)

Natural , synthetic mixed and NPK fertilizers – examples. -Impact of excessive use of fertilizers on environment – Bio fertilizers –Pesticides and their classification- examples. Excessive use of pesticides.

Environmental hazards.Safe handling of pesticides. Insect repellants

Unit 3. FUELS, CELLS &BATTERIES (7hrs)

Definition and classification of fuels – Characteristics of good fuel – Combustion - Calorific

value – wood- coal - petroleum-origin –differentfractions, their composition & uses. Natural gas, Biogas & LPG – their composition and uses.

Pollution due to burning of fossil fuel -Batteries and fuel cells – Different types – Applications

in modern life.

Unit 4 CEMENT&GLASS(6hrs)

Cement- Classification – Portland cement – Raw materials – manufacture – setting and

hardening – Glass – Different types – manufacture – raw materials – manufacture of ordinary glass

5. COSMETICS(6hrs)

Cosmetics – Cleansing cream,cold cream, bleaching &vanishing creams, perfumes, talcum

powder, tooth paste, deodorants , lipstick –ingredients. Harmful chemicals in cosmetics

References:-

1. J Barrett: Chemistry in your environment-User friendly, Simplified Science.

2. Howard L White: Introduction to Industrial Chemistry

3. David M Targarden: Polymer Chemistry – Introduction to an indispensible

science.

4. M.S.Yadav: Synthetic drugs

5. Samuel Delvin: Dyes and Pigments

6. Alexander Findlay: Chemistry in the service of man

7. S. K Honda: Principle of pesticide chemistry

8. M.M.Chakrabarthy: Chemistry and Technology of oils and fats

9. ShaliniSareen: Chemotherapeutic agents

10. P.K.Ray: Pollution and health

11. Vanessa Good ship: Introduction to plastic recycling

12.RandySchmetter and Perry Romanoswski: Beginning cosmetic chemistry.

13. V Jain: Organic polymer chemistry

14.V K Selva raj: Advanced polymer chemistry

15. Jr Charles E Carraher: Introduction to polymer chemistry

16. Shashi Chawla: A Text Book of Engineering Chemistry

17. Jain &Jain : Engineering Chemistry

Distribution of Marks for Generic Elective Course
Marks including choice:

Unit	Marks	Unit	Marks
I	9	V	5
II	6		
III	5		
IV	5		

Table 10. Type of Questions & Marks for External Examination – Generic Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Marks for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

GENERIC ELECTIVE COURSE

DRUGS - USE & ABUSE

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D02PCH/CHE	2	2	2

Contact hours: 36 Hrs

Credit 2

Course Outcome

On successful completion of this course, students should be able to

CO 1) Familiarise the classes of drugs and their examples

CO 2) Distinguish prescription drugs and over the counter drugs

CO 3) Understand the roots of administration of drugs and their importance

CO 4) Familiarise various synthetic drugs and their uses

CO 5) Understand the consequences of misuse of antibiotic

CO 6) Recognise the drugs of abuse and understand the consequences of drug abuse

INTRODUCTION(5HRS)

Drugs- Definitions, Classifications – Prescription drugs and Over the Counter drugs- examples of drugs- Roots of drug administrations,Enteral, parentaral and topical routes. Bioavailibility of drugs -Advantage and disadvantage of various routes of administrations-

PHARMACOKINETICS (10HRS)

Definition of Pharmacokeinetics- A brief explanation of Absorption, Distribution- Metabolism (Biotransformation) and Excretion . First pass metabolism,Therapeutic index , Drug tolerance, Placebo , Adverse drug reactions .

SYNTHETIC DRUGS (8HRS)

Examples of Antipyretics , analgesics and anti inflammatory agents . A brief explanation of their mode of action .Anti biotics- Discovery and its importance. Examples of antibiotics -

Antibiotic misuse .Anti histamines- examples , Antacids , anti- ulcer drugs . Drugs acting on Central Nervous System, Cardiovascular drugs classification and examples.

MISCELLANEOUS DRUGS (**6 HRS)**

Antiseptics and disinfectants, Vaccines, Vitamins and Minerals, Enzymes and Hormones, Treatment in poisoning.

DRUGS OF ABUSE:- (**7HRS)**

Classification of drugs of abuse -Narcotic analgesic CNS Stimulants ex samples and effects, Depressants, Hallucinogens examples and effects, Sadatives, hypnotics example and effects ,Opioids, Cannabis and Inhalants examples and effects . Drug dependence, withdrawal symptoms , tolerance and addiction.

References

1. Drugs - G.L. David Kurupadanam,Vijayaprasad,KVaraphiipatrasad Rao et.al.

2. Medical Pharmacology- PadmajaUdayakumar

3. Essentials of Medicinal Pharmacology - Tripathi

4. Medicinal Chemistry - AshuthoshKar

5.Dispensing Pharmacy -Kapoor & Gunn

6. A Text Book of Forensic Pharmacy - B.M. Mithal.

7. A Text Book of Organic and Pharmaceutical Chemistry - Wilson &Gisvold

Distribution of Marks for Generic Elective Course
Marks including choice:

Unit	Marks	Unit	Marks
I	5	V	5
II	8		
III	8		
IV	4		

Table 10. Type of Questions & Marks for External Examination – Generic Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Marks for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

GENERIC ELECTIVE COURSE

Environmental Studies

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D03PCH/CHE	2	2	2

Contact hours:36Hrs

Course Outcome

On successful completion of this course, students should be able to

CO 1) Differentiate the environmental segments and understand the importance of environmental segments

CO 2) Identify the types of environmental pollution and the various sources of the pollution

CO 3) Understand the consequences of environmental pollutions

CO 4) Explain the measures of control of environmental pollution

CO 5) Recognise various sustainable energy sources

UNIT1. Environmental segments 6 Hours

Environmental segments – Lithosphere: soil formation – components of soils.Hydrosphere: Hydrological cycle- Biosphere - Atmosphere- Structure and composition

UNIT 2. Air Pollution 9 Hours

Types of pollutants

Air pollution –Sources – pollutants –CO, NOx, Sox, Hydrocarbons, Particulates. Effect on ecosystem., Ozone layer –importance, Ozone depletion-Control measures- Acid rain-controlof acid rain- Green house effect-global warming,-photochemical smog(Eqns not needed)- effect pollution on plants and human beings. Control of air pollution Noise Pollution – physiological response to noise – biological effects- carbon foot print

UNIT 3.Water Pollution 7 Hours

Water Pollution – Sources –Industrial effluents- agriculture discharge - oil spills-

heavy metal -pesticides-biomagnifications and bioaccumulations

Dissolved oxygen in water, chemical oxygen demand (COD) and biochemical Oxygen demand(BOD)(Definition only)- control of water pollution- ISI/BIS standards of drinking water

UNIT 4. Soil Pollution8 Hours

Soil Pollution - Sources by industrial and urban wastes, radioactive pollutants, plastics

heavy metals.Poisoning by heavy metals – Mina- matha&itai-Itai diseases.

Control of soil pollution.- Solid waste Management -Thermal pollution

definition-sources of thermal pollution , harmful effect of thermal pollution

prevention of thermal pollution.

UNIT 5. Sustainable Energy Sources & Technology 6 Hours

Green energy Sources- Wind-water-solar– use of solar energy in space-

Production of electricity using solar energy- Tidal, Biomass and geothermal energy

References:

1.Text book of Environmental Studies for under graduate courses – ErachBhar

2. Essential Environmental studies- S. P. Misra – S. N. Pandey

3. Environmental chemistry and pollution control – S.S Dara (2^{nd} Edition)

4. Environmental chemistry- Peter O' Neill

5. Environmental chemistry – B.K. Sharma

6. Fundamental concepts of environmental chemistry – G.S Sodhi

7. Environmental Chemistry. A.K De

Distribution of Marks for Generic Elective Course
Marks including choice:

Unit	Marks	Unit	Marks
I	4	V	4
II	10		
III	7		
IV	5		

Table 10. Type of Questions & Marks for External Examination – Generic Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Marks for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

GENERIC ELECTIVE COURSE

NANOMATERIALS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D04PCH/CHE	2	2	2

Contact hours:36 Hrs

Course Outcome

On successful completion of this course, students should be able to

CO 1) Understand the basic concepts of nanoscale science and technology.

CO2) Inculcate the enquiry based learning and increase the level of interest in nanoscience.

CO3) Understand the societal implications and the scope of nanotechnology.

1. Introduction to Nanomaterials (10hrs)

Nanotechnology-Definition,Size and Scale, Historical milestone. Medicinal use of gold in ancient India.Nano objects in nature (few examples). Classification of Nanomaterials based on dimesnsions (0D, 1D, 2D, 3D) Examples. Fullerenes, graphenes, carbon nanotubes properties and applications.Polymer nano compositesand their applications (brief study).

2. Nano particle synthesis (14hrs)

Biological synthesis using plant extract.Chemical/bottom up method: Chemical precipitation method, Sol gel method, Metal nano crystals by reduction, Microwave irradiation (brief study)**.** Physical- method: Ball milling (Top down), Vapour deposition (brief study). Lab.demonstration of any of the synthesis method.Methods for characterization viz:XRD,SEM,TEM(mention only)

3. Scope/Applications of Nanotechnology (12 hrs)

Nano technology for sustainable development: Solar energy conversion (DSSC) and storage (Supercapacitors). Self cleaning surfaces.Water purification using nanomaterials (nanofilters), desalination of water, heavy metal and oil spill removal.Biological applications-Imaging, labeling, targeted drug delivery (preliminary ideas only). Applications in Nanoelectronics, Sports equipments, and cosmetics (brief study).

References:

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

2. C. N. R. Rao and A.Govindraj, Nanotubes and Nanowires, Royal Society of Chemistry(2005).

3V. S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009.

4. Dr.AshuthoshSharma,Dr.Bellari, Advances in Nanoscience and Nanotechnology- -CSIR Publication 2004
5. G. A. Ozin et.al, Nanochemistry: A Chemical Approach to Nanomaterials – Royal Society of Chemistry, Cambridge, UK 2005.
6. R. Booker and , E. Boysen, Nanotechnology, Wiley India Pvt Ltd, 2008.
7. K. J. Klabunde, Nanoscale materials in chemistry, John Wiley and Sons.
8. S.M. Lindsay, Introduction to Nanoscience, Oxford University Press.
9. K.K. Chattopadhyay and A. N. banergee, Introduction to nanoscience and Technology, PHI learning pvt. Ltd. Delhi.
10. Sulabha K. Kulkarni, Nanotechnology Principles and Practices, Capital Publishing Company,Kolkatta.
11. http://www.zyvex.com/nanotech/feynman.html
12. https://www.azonano.com/

Distribution of Marks for Generic Elective Course

Marks including choice:

Unit	Marks
I	8
II	12
III	10

Table 10. Type of Questions & Marks for External Examination – Generic Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Marks for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

GENERIC ELECTIVE COURSE

CHEMISTRY IN EVERYDAY LIFE

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D05PCH/CHE	2	2	2

Contact hours - 36 hours

Course Outcome

CO 1) Identify the harmful ingredients and their effects of cleansing agent and cosmetics

CO 2) Familiarise adulterants in food, food additives and food preservatives

CO 3) Explain the harmful effects of modern food habits

CO 4) Classify the drugs and familiarize the applications of various drugs

CO 5) Understand the consequences of misuse of antibiotics

CO 6) Prepare toilet soap using vegetable oil

Module 1

Cleansing Agents and Cosmetics (12 hrs)

Cleansing Agents: Soaps - Hard and soft soaps - Alkali content – TFM - Detergents (classification) – Cleaning action - Advantages and disadvantages of soaps and detergents

Shaving creams, Shampoos: Ingredients and functions - Different kinds of shampoos (Anti-dandruff, anti-lice, herbal and baby shampoos).

Tooth paste: Composition and health effects. Cosmetics: Hair dye: Chemicals used and its harmful effects.

Face and skin powders: Types, ingredients and functions. Cleansing creams: Cold creams, vanishing creams and bleach creams.

Perfumes, antiperspirants, Sun screen preparations, nail polishes, lipsticks, eyebrow pencils and eye liners (ingredients and functions) – Harmful effects of cosmetics.

Module II: Food (10 hrs)

Common Adulterants in Different Foods: Milk and milk products, vegetable oils, cereals, tea, coffee powder, chilly powder and beverages.

Food Additives and food preservatives – Commonly used permitted and non-permitted food colours

Artificial sweeteners – Taste enhancers - Artificial ripening of fruits and its side effects.

Modern Food Habits: Definition and health effects of fast foods, instant foods, dehydrated foods and junk foods. Harmful effects of modern food habits.

Module III Practical: (8 Hrs) Training on Soap Manufacturing

Module IV

MEDICINES (6hrs)

Drugs- classification-examples and uses . Antibiotics -Discovery, examples and importance. Misuse of antibiotics.Antipyretics ,analgesics and anti-inflammatory agents , narcotic analgesics Anesthetic,

Antiseptic, Anti histamines and tranquillizers, - examples, and use. Disinfectant &germicides examples, .importance and uses.

References

1) B.K. Sharma, Industrial Chemistry, 11th Edition, Goel publishing House, Meerut, 2000.

2) Lillian Hoagland Meyer, Food Chemistry, 1st Edition, CBS Publishers & Distributors, New Delhi, 2004.

3) Brian A. Fox, Allan G. Cameron and Edward Arnold, Food Science, Nutrition and Health, 6th Edition, Edward Arnold, London, 1995.

4) . M.S.R. Winter, A Consumer's Dictionary of Cosmetic Ingredients, 7th Edition, Three Rivers Press, New York, 2009.

5) 6. Alexander Findlay: Chemistry in the service of man

Distribution of Marks for Generic Elective Course
Marks including choice:

Unit	Marks
I	8
II	8
III	10
IV	4

Type of Questions & Marks for External Examination – Generic Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Marks for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

SYLLABUS FOR GENERAL COURSE

POLYMER CHEMISTRY

. **CHOICE BASED CREDIT AND SEMESTER SYSTEM**

(2019 ADMISSION ONWARDS)

GENERAL AWARENESS COURSE I : POLYMER CHEMISTRY- I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3A11PCH	3	3	3

On successful completion of this course, students should be able to

CO 1: Understand the basic concepts of monomers, polymers and polymerisation reactions

CO2: Familiarise the preparation, properties and applications of some synthetic polymers.

CO3: Understand the importance of molecular weight and the distribution of molecular weight in polymers.

CO4: Summerise the techniques available for testing and characterization of polymers

Contact Hours : 54

Unit – 1. Introduction to Polymers (10 hrs)

Basic concepts- historical development- Present status - Basic concept of monomers- Functionality. Nomenclature of Polymers – Common names- Source based names- Structure based names- Linkage based names- Trade names- Abbreviations- Classification of polymers and characteristic features of each- Natural and synthetic polymers-Organic and Inorganic polymers-Thermoplastics and Thermo setting Plastics, Elastomers, Fibers and Liquid resins-Addition polymers and Condensation polymers- Linear, Branched and Cross- linked polymers - Homopolymers and Copolymcrs- Types of copolymers-Alternate, Graft, Block and Random copolymers

Unit-2 Commercial Polymers (18 hrs)

Synthesis, properties and applications of the following plastics - LDPE, HDPE, Polypropylene, Polystyrene, PVC, PTFE, PMMA, PAN, Polyacrylic acid, Polymethacrylic acid-.Polyamides -Nylon 6,6 and Nylon 6. Aromatic polyamides - Nomex, Kevlar- Polyesters –PET and Glyptal -Unsaturated polyesters. Polycarbonates - Acetal resins - Polysulphones – PPO - Phenolic resins-Novalac formation - Resole formation. Urea formaldehyde, Melamine formaldehyde resins.

Unit -3 MoleculIar weight of PoIymcrs (10 hrs)

Importance of molecular weight – Average molecular weight - Number average, weight average, Sedimentation and Viscosity average molecular weights - molecular weight and degree of polymerization - Polydispersity and PDI -Molecular weight distribution in polymers and its importance from the point of application - Molecular weight mechanical properties.

Unit - 4 Characterization of Polymers (16 hrs)

Molecular weight determination-Methods based on colligative property measurements- cryoscopy-ebullioscopy -osmometry - membrane osmometry -vapour-pressure osmometry- Methods based on viscosity measurements -viscometry -Light scattering method- ultracentrifuge techniques – Sedimentation velocity method – Sedimentation equilibrium method - End group analysis - GPC method. Thermal methods of analysis in polymers TGA. DTA, DSC. Applications of IR, UV, NMR, Raman and Mass spectroscopy in polymers (Basic concepts only) – Applications of optical microscope, SEM, TEM, XRD in polymers (Basic concepts only).

References

1. Text book of polymer science - P.L Nayak and S. Lenka
2. Physical Chemistry of polymers - A Tager
3. A text Book of Polymer Science - F. W. Billmeyer.
4. Polymer Science - V.R. Gowariker, N.V. Viswanathan, J. Sreedhar
5. Principles of Polymers Chemistry - P.J. Flory
6. Rubber Technology - Maurice Morton

7. Rubber Technology and manufacture - C.M. Blow

8. Synthetic rubbers. - D.C Blackley
9. Hand book of rubber Test method - Plastic test method - R.P. Brown
10. High performance Polymers, their origin and development – Seymour, R.B.Klrschenbaun, G.S. Elsevier.

11. Principles of polymerization - F. Rooriquez.
12. Polymer Chemistry - M.G Arora & M. Singh
13. Mechanical properties of polymers and composites - L.E. Nielsen, marcel, Dekker
14. Experiments and calculations in engineering chemistry - S.S. Dara
15. Principles of polymerisation, P. Bahadhur, N.V. Sastry, Narosa Publishing House, New Delhi - 2002

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	12
II	20
III	12
IV	18

Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

GENERAL AWARENESS COURSE II : POLYMER CHEMISTRY- II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3A12PCH	3	3	3

On successful completion of this course, students should be able to

CO 1: Familiarize the different techniques of polymerisation.

CO2: Understand the chemistry of polymerisation

CO3: Understand the kinetics of polymerisation

CO4: Summerise the process of polymer dissolution and polymer fractionation.

Contact Hours : 54

Unit – 1. Techniques of Polymerization (12 hrs)

Bulk polymerization - Solution polymerization - Suspension polymerization – Emulsion polymerization - Advantages and disadvantages of these techniques – Melt polycondensation – Solution polycondensation – Interfacial condensation – Solid and Gas phase polymerization – Batch and Continuous process.

Unit -2 Chemistry of Polymerization (17 hrs)

Addition polymerization -Free radical polymerization -Initiation, Propagation and termination - inhibitors and retarders-Ionic polymerization -cationic and anionic –Living Polymers - Co-ordination polymerization - Zeigler -Natta catalysts - Condensation polymerization -Extent of reaction and DP - Carother's equation and its significance. Three dimensional polymerization -cross linking -gel point -Ring scission polymerization.

Unit -3 Kinetics of Polymerization (13 hrs)

Kinetics of free-radical, anionic and cationic chain polymerization -Kinetic chain length and DP - Derivation for rate expression and expression for kinetic chain length and hence degree of polymerization –Ceiling temperature- Kinetics of cationic and anionic polymerizations - Kinetics of polycondensation – Non-catalysed polycondensation and Acid catalysed polycondensation - Simple kinetic expression.

Unit -4 Polymer Solutions (12hrs)

The process of polymer dissolution -Thermodynamics of polymer dissolution- effect of molecular weight on solubility – Solubility of crystalline and amorphous polymers- polymer fractionation - Fractional precipitation technique -Partial dissolution technique - Gel permeation chromatography-Gradient elution technique.

References

1. Text book of polymer science - P.L Nayak and S. Lenka
2. Physical Chemistry of polymers - A Tager
3. A text Book of Polymer Science - F. W. Billmeyer.
4. Polymer Science - V.R. Gowariker, N.V. Viswanathan, J. Sreedhar
5. Principles of Polymers Chemistry - P.J. Flory
6. Rubber Technology - Maurice Morton

7. Rubber Technology and manufacture - C.M. Blow

8. Synthetic rubbers. - D.C Blackley
9. Hand book of rubber Test method - Plastic test method - R.P. Brown
10. High performance Polymers, their origin and development – Seymour, R.B.Klrschenbaun, G.S. Elsevier.

11. Principles of polymerization - F. Rooriquez.
12. Polymer Chemistry - M.G Arora & M. Singh
13. Mechanical properties of polymers and composites - L.E. Nielsen, marcel, Dekker
14. Experiments and calculations in engineering chemistry - S.S. Dara
15. Principles of polymerisation, P. Bahadhur, N.V. Sastry, Narosa Publishing House, New Delhi - 2002

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	14
II	18
III	15
IV	15

Type of questions & Marks for External Examination – Core Polymer Chemistry

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

GENERAL AWARENESS COURSE III : POLYMER CHEMISTRY- III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4A13PCH	3	3	3

On successful completion of this course, students should be able to

CO 1: Understand the basic principles of plastic processing and processing techniques.

CO2: Familiarise various methods for testing of polymers and polymer products.

CO3: Understand the Molecular forces and chemical bonding polymers

CO4: Understand the preparation and properties of inorganic polymers.

Contact Hours : 54

Unit 1. Molecular forces and chemical bonding in Polymers (15 hrs)

Secondary bonding forces that exist in polymers - Tacticity in polymers-Isotactic, syndiotactic and atactic polymers - Crystallinity and amorphous behavior of polymers- Degree of crystallinity- Crystability- Crystallites- Spherulites-Factors affecting crystallinity- Effect of crystallinty on the properties of polymers - Thermal transition in polymers- Tg and Tm – Thermal transitions and associated properties- Factors affecting Tg - Glass transition temperature and molecular weight - Importance of Tg - Plasticizers and their action on Tg -.Determination of Tg-Dilatometric method, Thermomechanical method - Calorimetric method.

Unit 2. Inorganic Polymers (10 hrs)

General properties - classification -Boron based polymers - Borazine, Polymeric boron nitride - Phosphorous based polymers -Polyphosphonitrilic chloride -polyphosphoric acids -Silicon based polymers – Organo tin polymers.

Unit- 3. Plastic Processing (15 hrs)

Basic principles of processing - shape and size -processing parameters – their effects and behavior - Rheology of ideal fluids and polymers-Polymer compounding - additives –fillers- Plasticizers – antioxidants- Flame retardants- stabilizers - colourants etc. Processing techniques: Injection moulding - Compression moulding - Transfer moulding -Blow moulding - Extrusion moulding - Rotational moulding – Calendering – Foaming – Laminating – Coating – Casting - Spinning and Thermoforming.

Unit- 4. Testing of Polymers and Polymer products. (14 hrs)

Need for testing - Need for Standards and specification -National and International standards - Organizations like ASTM, BIS, BS, DIN, ISO etc. Mechanical properties: Short term strengths - Tensile properties- compression properties- flexural properties, shear properties- Long term strength - dynamic stress and strain properties and their measurements – creep- stress relaxation - fatigue properties. Hexing and resilience.

References

1. A text Book of Polymer Science - F. W. Billmeyer.
2. Polymer Science - V.R. Gowariker, N.V. Viswanathan, J. Sreedhar
3. Principles of Polymers Chemistry - P.J. Flory
4. Rubber Technology - Maurice Morton
5. Rubber Technology and manufacture - C.M. Blow
6. Synthetic rubbers. - D.C Blackley
7. High performance Polymers, their origin and development - Seymour R. B.Klrschenbaun, G.S. Elsevier.
8. Principles of polymerization - F. Rooriquez.
9. Polymer Chemistry - M.G Arora & M. Singh
10. Experiments and calculations in engineering chemistry - S.S. Dara
11. Principles of polymerisation, P. Bahadhur, N.V. Sastry, Narosa Publishing House, New Delhi – 2002

Marks including choice:

Unit	Marks
I	17
II	14
III	16
IV	15

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Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10

	20	14		32

GENERAL AWARENESS COURSE IV : POLYMER CHEMISTRY- IV

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	**4A14PCH**	**3**	**3**	**3**

On successful completion of this course, students should be able to

CO 1: Understand the preparation and properties of natural and synthetic rubbers

CO2: Describe the type of polymer degradation.

CO3: Describe various methods used for latex technology and compounding of rubber.

CO4: Familiarise the special topics in polymer science.

Contact Hours : 54

Unit 1. Natural & Synthetic polymers (19 hrs)

Natural rubber - structure and properties of NR and Gutta percha - Manufacture, general properties and applications of SBR, Polyisoprene, Polybutadiene, Butyl rubber-Ethylenepropylene rubber- Neoprene rubber- Speciality rubbers: Silicon rubbers- Nitrile rubbers- polyacrylic rubbers- polyurethane rubbers- Hypalon, reclaimed rubber- foam rubber. Cellulose - Cellulose based polymers - cotton, Rayon, Nitrocellulose and cellulose acetate – shellac- casein.

Unit 2. Latex Technology (14 hrs)

Rubber latex -Latex processing - Preserved field Latex-Latex concentration by processes like centrifuging and creaming -Preparation of Ribbed Smoked Sheets – Technically specified forms of rubber - Superior processing rubbers-Latex compounding – additives used – manufacture techniques of rubber goods from latex -dipping -casting and moulding-Latex form rubber. Rubber processing - Mastication -Additives used in rubber compounding. Vulcanization -Sulphur vulcanization and non - sulphur vulcanization. Unique properties of Rubber.

Unit- 3. Polymer Degradation (8hrs)

Polymer degradation - Type of degradation - Thermal degradation - factors affecting thermal stability – Polymer degradation involving substituent groups-mechanical degradation– Degradation by ultrasonic waves - Photodegradation - Photostabiiizers - Degradation by high energy radiation - Oxidative degradation – Oxidative degradation of saturated polymers – antioxidants – Hydrolytic degradation.

Unit- 4. Special Topics in Polymer Science (13 hrs)

Blends -Composites – Nanocomposites - Examples and application in engineering, biochemical, agriculture, defense and aerospace. Specialty polymers -Bio medical polymers. Conducting polymers, engineering polymers- applications. Plastic Waste management -Chemical recycling -incineration - Pyrolysis –mixed waste recycling - Types of recycling (1 °, 2°, 3° & quartemary - Basics) – Recycling codes – development for recycled materials.

References

1. A text Book of Polymer Science - F. W. Billmeyer.
2. Polymer Science - V.R. Gowariker, N.V. Viswanathan, J. Sreedhar
3. Principles of Polymers Chemistry - P.J. Flory
4. Rubber Technology - Maurice Morton
5. Rubber Technology and manufacture - C.M. Blow
6. Synthetic rubbers. - D.C Blackley
7. Hand book of rubber Test method - Plastic test method - R.P. Brown
8. High performance Polymers, their origin and development - Seymour R. B.Klrschenbaun, G.S. Elsevier.
9. Principles of polymerization - F. Rooriquez.
10. Polymer Chemistry - M.G Arora & M. Singh
11. Mechanical properties of polymers and composites - L.E. Nielsen, marcel Dekker
12. Experiments and calculations in engineering chemistry - S.S. Dara
13. Principles of polymerisation, P. Bahadhur, N.V. Sastry, Narosa Publishing House, New Delhi – 2002
14. Hand book of Plastics Testing Technology -Vishu Shah, wiley interscience publications, 2nd edn. 1998
15. Synthetic rubbers, D.C. Blackley - Applied Science publisher London – 1983
16. Polymer Chemistry - Properties and applications, Andrew Peacock, Allison calhoun,Hanser Publishers, Munich 2006
17. Nabil Mustafa - “Plastic waste management” - Marcel Dekker Inc – 1993
18. Chandra. R and Adab. A. Rubber and Plastic waste, CBS Publishers & Distributers, New Delhi 1994

Marks including choice:

Unit	Marks
I	21
II	16
III	10
IV	15

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

GENERAL AWARENESS COURSE PRACTICAL

3A12(A)PCH POLYMER CHEMISTRY II – PRACTICAL -I

36 hrs/ credit 2

On successful completion of this course, students should be able to

CO 1) Apply the theoretical concepts while performing experiments.

CO2) Acquire practical skill to identify different types of plastics and rubbers.

CO3) Estimate the synthesis of different polymers by various techniques.

CO4) Acknowledge experimental errors and their possible sources.

CO5) Design, carry out, record and analyze the results of chemical experiments

1. Identification of Plastic and Rubbers (10 samples)
2. Preparation of Polymer - PMMA, Nylon 6, 6., Polystyrene by mass polymerization, Polystyrene by Pearl polymerization, Polyacrylamide by Free radical polymerization,

Polyacrylamide by Redox polymerization, Polyaniline, Phenol formaldehyde resin, Ureaformaldehyde resin, Aniline - formaldehyde resin.

Preparation of Poly Vinyl Alcohol from polyvinyl acetate

Preparation of cellulose acetate

4A13(A)PCH POLYMER CHEMISTRY III – PRACTICAL -II

36 hrs/ credit 2

On successful completion of this course, students should be able to

CO 1) Apply the theoretical concepts while performing experiments.

CO2) Acquire practical skill to determine ammonia content of latex.

CO3) Estimate the molecular weight of polymers by viscometer.

CO4) Develop skills to determine acid value/hydroxyl value of polymers.

CO4) Acknowledge experimental errors and their possible sources.

CO5) Design, carry out, record and analyze the results of chemical experiments

1. Latex Analysis-Determination of Dry Rubber Content, Total solid content, Ammonia Content, of latex
2. Relative Viscosity measurement of Polymer solutions
3. Analysis and estimation of phenolic group by bromination method.
4. Determination of mwt by Viscometer - polyvinyl Alcohol / Polystyrene
5. Determination of mwt by end group analyasis
6. Determination of acid value / and Hydroxyl value of polymers
7. Determination of chlorine content of PVC

Reference:

1. Experiments in polymer science, D.G Hundiwale, V.D. Athawale, U. R Kapadi, V.V. Gite New age International Pvt. Ltd - New Delhi - 2009
2. Polymer Chemistry - Practical approach in Chemistry, F.J. Davis, Oxford University press.

3 Polymer Science - V.R Gowarikar, N.V. Viswanathan, Jayadev Shredhar, New Age International Pvt. Ltd. New Delhi - 1997 81
4. Principles of Polymerisation - P. Bahadhur N.V. Sastry. Narosa Publishing House - NewDelhi - 2002

COMPLEMENTARY ELECTIVE COURSE

Chemistry for Physical & Biological Sciences

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	1C01PCH/CHE	2	2	2

Contact Hrs –36

Course Outcome

On successful completion of this course, students should be able to

CO1) Understand the atomic structure, basics of quantum chemistry and its applications.

CO2) Explain theories of chemical bonding and molecular structure.

CO3) Classify environmental pollution and recognise the causes of pollution

CO4) Understand the basic concept of Chemical equilibrium and theories of acids and bases

CO 5) Calculate pH values

CO 6) Explain common ion effect and solubility product

UNIT I : Atomic Structure and Periodic Table (10 hrs)

Bohr atom Model (No derivation) – Atomic Spectra of Hydrogen – limitations – wave mechanical concept of atom – Heisenberg's Uncertainty Principle – Dual nature of electrons – De Broglie equation – quantum numbers. Orbit and orbitals – Wave function and significance of ψ^2. Schrodinger equation (no derivation). The periodic table – periods and groups-s, p, d and f block elements – modern concept – periodic trends – atomic radii, ionic radii & covalent radii – effective nuclear charge and screening effect – Ionization potential – electro negativity and electron gain enthalpy.

UNIT II : Chemical bonding (10 hrs)

Types of chemical bonds-Ionic, covalent and co-ordinate bonds. Lattice energy of ionic compounds – Born Haber cycle. VSEPR theory and its applications. Shape of molecules CO_2, BeF_2, BF_3, CH_4, NH_3, H_2O, NH_4^+, PCl_5, SF_6, ClF_3. Orbital overlapping – Hybridization sp, sp^2, sp^3, sp^3d, sp^3d^2, d^2sp^3 and dsp^2 hybridization.
V.B Theory. MO theory.Formation of B_2, C_2, N_2 and O_2 molecules. Hydrogen bonding, types of hydrogen bonding – example

UNIT III : Environmental Chemistry (10 hrs.)

Introduction-environment and segments- Pollutants of water – sewage, industrial effluents, soap and detergents, pesticides, fertilizers, heavy metals, Biological magnification and bioaccumulation, Toxic effect of pollutants, Water quality parameters – DO, BOD and COD, Water purification-sedimentation, coagulation, filtration, disinfection, ion exchange, desalination, Air pollution – major regions of atmosphere, pollution by oxides of N, S, C, hydrocarbons and other organic chemicals, automobile exhausts, their physiological effects on vegetation and living organisms, Ozone layer – importance – depletion of ozone – consequences, Greenhouse effect – global warming – acid rain, Toxicity and environmental hazards of pesticides, Radiation pollution and noise pollution.

UNIT IV :Ionic Equilibrium (6 Hrs)

Concepts of Acids and Bases-Arrhenius, Lowry- Bronsted and Lewis concepts, ionization of weak electrolytes.pHand pOH values. Buffer solutions and calculations of their pH. Henderson equation(numerical problems expected). Solubility product and common Ion effect.Hydrolysis of salt – degree of hydrolysis and hydrolytic constant, derivation of relation between Kw and Kh for salts of strong acid – weak base, weak acid – strong base and weal acid – weak base.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks
I	14
II	14
III	14
IV	10

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistry for Physical & Biological Sciences

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	2C02PCH/CHE	2	2	3

Contact Hrs – 36

Course Outcome

On successful completion of this course, students should be able to

CO 1) Understand the basic concept of classification, IUPAC nomenclature, bonding and structure of Organic compounds

CO2) Explain the concept of aromaticity and non-benzenoid aromatics

CO3) Understand the basic concepts of chemical equilibrium . Explain colloids, their properties

and applications

CO4) Illustrate the laws of photochemistry and Explain the photochemical phenomena such as Photo sensitization, quenching, Fluorescence, Phosphorescence, Chemi luminescence and

bioluminescence.

CO5) Familiarise different types of analytical methods in chemistry and explain the principle of

colorimetry

CO 6) Explain the principles underlying the qualitative and quantitative analysis

UNIT I : : Introduction to organic chemistry (8 Hrs)

Classification of organic compounds – functional groups,Homologous series –Hybridization and shapes of molecules like methane, ethane, ethylene and acetylene – IUPAC nomenclature of hydrocarbons, organic compounds bearing functional groups –Structure of Benzene –

Aromaticity-Huckel's rule. Non Benzenoid Aromatic systems-cyclopropenyl cation, cyclopentadienyl anion, tropelium cation, Pyrrole, Pyridine

Bond fission – homolysis and heterolysis – carbonium ion – carbanion – and free radicals.

. **UNIT II : Chemical equilibrium (6 hours)**

Reversible reactions – Law of mass action – relationship between Kc, Kp and Kx- thermo dynamic derivation of chemical equilibrium. Liquid systems – Le-Chatlier's Principle – Effects of

temperature, pressure and concentrations.

UNIT III : Photochemistry (4 hrs)

Chemical reactions Vs Photochemical Reactions. Laws of photo chemistry – Grotthus – Draper Law and Stark-Einstein law of photo chemistry. Beer Lambert Law- Quantum yield – Photo sensitization and quenching- Fluorescence and Phosphorescence – Chemiluminescence and bioluminescence.

UNIT IV : Colloids (8 hrs)

Classification – preparation – structure and stability – The electrical double layer – zeta potential – Properties of Colloids – Tyndall effect – Brownian movement- Coagulation of colloidal solution – Hardy-Schultz rule – Flocculation value – protective colloids – Gold number – Emulsions – oil in water and water in oil type emulsions – Emulsifying agents – Gels – imbibition – syneresis – applications of colloids in food, medicine and industry.

UNIT V : Analytical Chemistry (10hrs)

Analytical chemistry – Types of analytical methods –Qualitative and Quantitative analysis, Electrochemical methods, Spectroscopic analysis, Thermal methods (introduction only) –

Accuracy and precision. Errors-classification

Inorganic Qualitative analysis - Solubility product – ionic product – common ion effect- principle of separation of cations in various groups.

Concept of molarity, Normality, Molality (numerical problems expected). Principle of volumetric analysis – Acidimetry and alkalimetry, permanganometry, dichrometry, iodometry and iodimetry.

Colorimetry – Beer-Lamberts law-applications.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks	Unit	Marks
I	12	V	13
II	9		
III	6		
IV	12		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistry for Physical Science

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3C03PCH/CHE (PS)	3	2	3

Contact Hrs –54

Course Outcome

On successful completion of this course, students should be able to

CO1) Understand the basic principle underlying various spectroscopy

CO2) Understand the basic concepts of thermodynamics and laws of thermodynamics

CO3) Explain the formation , nomenclatureand applications of coordination complexes,

Illustrate the valance bond theory of coordination complexes and explain the factors

affecting the stability of complexes

CO4) Understand the basic concepts of chemical kinetics and Calculate the value of Ea from the values of k at two temperatures . Illustrate the types of Catalysis and understand the Characteristics of catalytic reactions

CO 5) Understand the basic concept of nuclear chemistry, and explain the detection of isotopes using Aston's mass spectrograph and separation of isotopes by diffusion methods
CO6) Explain the principle and applications of different types of Chromatography

Module I : Spectroscopy (9 Hrs)
Electromagnetic spectrum- Ranges of different radiation- general features of spectroscopy- Types of spectra – Rotational, vibrational and electronic spectra. Rotational spectra - Moment of inertia- rotational constant and bond length.

Vibrational spectra – stretching and bending modes-Force constant-Zero point energy.
Raman spectra – Stokes and Anti Stokes Lines – NMR spectra-chemical shift and spin-spin splitting.

Module II : Thermodynamics (8Hrs)

Basic Concepts – System – surroundings – open, closed and isolated systems – heat – energy – internal energy – Isothermal –isochoric and isobaric process – Reversible and irreversible processes- work of expansion of an ideal gas in reversible isothermal work –Heat capacity at constant volume (Cv) and at constant pressure (Cp) – relation between Cp and Cv – First law– The second law – Enthalpy-Entropy- and Free energy- significance of ΔG, ΔH and available work-Criteria for reversible and irreversible process - Gibbs –Helmholtz equation(no derivation)- criteria of spontaneous and non spontaneous processes.

Module III : Co-ordination compounds (8 Hrs)

Co-ordination compounds and complex ions –co-ordination number-Ligands – Types - unidentate-bidentate -polydentate ligands– Werners theory – Nomenclature of co-ordination compounds – Effective Atomic Number Rule – Factors affecting the stability of complex ions – valence bond theory of complexes –application of complexes.

Module IV : Chemical kinetics and catalysis (11hrs)

Definition – reaction rate – factors affecting the rate of a chemical reaction – units – Zero order reactions – Order versus molecularity. Pseudo order reactions – Integrated rate equation for first order reaction – half life – determination of the order – Half life method and Graphical method – Ester hydrolysis – rate equation. Collision theory (qualitative) Effect of temperature on reaction rate Calculation of Ea from the values of k at two temperatures.Transition state theory (qualitative). Types of catalysis – homogeneous and heterogeneous.Characteristics of catalytic reactions – promoters and catalytic poisons. Activation energy and catalysts.

Module V : Nuclear Chemistry (10 hrs)

Concept of nuclides – representation of nuclides – isobars, isotopes and isotones with examples – Detection of isotopes using Aston's mass spectrograph – separation of isotopes by diffusion methods – stability of nucleus – n/p ratio. Liquid drop model, Radioactivity – natural and artificial. Decay constant and half-life period-Radioactive series – Group displacement law – radio isotopes and their applications in structural elucidation, in agriculture and in industry – Radiocarbon dating – Nuclear fission and nuclear fusion. Problems associated in the nuclear

waste disposal. Derivation of decay constant – Atom bomb and hydrogen bomb. Mass defect, Nuclear binding energy.

Module VI: Chromatography (8 hrs)

Introduction - Adsorption and partition chromatography - Principle and applications of column, thin layer, paper, Liquid and gas chromatography, HPLC, Ion Exchange chromatography (IEC) - R_f value – Relative merits of different techniques.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks	Unit	Marks
I	9	V	9
II	9	VI	6
III	9		
IV	10		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistry for physical science

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS

IV	**4C04PCH/CHE (PS)**	**3**	**2**	**3**

Contact Hrs –54

Course Outcome

On successful completion of this course, students should be able to

CO1) Understand the basic concept in gaseous state Explain the deviation of real gases from ideal behaviorand Maxwell distribution of velocitiesand its use in calculating molecular velocities. Distinguish average velocity, RMS velocity and most probable velocity

CO 2) Understand the basic concepts of internal structure of Crystals (crystallography) and explain X-ray analysis of crystals

CO3) Understand the basic concepts in liquid state and solutions .Illustrate Henry's law and explain its applications. Identify collegative properties and apply colligative properties to determine molecular mass

CO4) Distinguish Specific conductance – molar conductance and equivalent conductance and explain laws of electrolysis , conductometric titrations and its applications

CO5) Explain electrochemical cell ,electrode potential , types of electrodes ,EMF Nernst equation and potentiometric titration

CO6) Acquaint with various instrumental methods in chemistry and Understand basic concepts of nanochemistry

UNIT I: Gaseous State (9Hrs)

Gaseous State: Introduction - Kinetic molecular model of gases – Maxwell distribution of velocities and its use in calculating molecular velocities – Average velocity, RMS velocity and most probable velocity (derivations not required) – collision number and collision frequency, mean free path- Boyle's law – Charles's law – Ideal gas equation – Behaviour of real gases – Deviation from ideal behaviour - Van der Waals equation (derivation not required). Joule-Thomson effect and Liquifaction of gases .

UNIT II : Crystalline State (9 Hrs)

Solids – crystalline and amorphous solids – space lattice and unit cell- crystal planes laws of crystallography – Weiss indices and Miller indices - Bravais lattice – Bravais lattices of cubic

crystals – characteristic planes in these lattices – interplanar distance ratio – X-ray analysis of crystals – Bragg's equation – problem – crystal structure of NaCl – Liquid crystals – types, properties and applications.

UNIT III: Liquid State and Solutions (10 hrs)

Liquid State: Introduction - Vapour pressure – Raoult's law- surface tension and viscosity – Explanation of these properties on the basis of intermolecular attraction.

Solutions: Kinds of solutions - Solubility of gases in liquids – Henry's law and its applications - Colligative properties - Determination of molecular mass using colligative properties.

Introduction to liquid crystals-classification and properties

Unit IV Electrochemistry(6 hrs)

Specific conductance – molar conductance and equivalent conductance – variation with dilution. Ohm's law - Conductors - metallic and ionic conductors

Electrolysis – laws of electrolysis –. Electrolytic conduction - Migration of ions – relative speed of ions – Transport number. Kohlrausch's law and applications.Conductometric titrations – advantages

UNIT V : Electromotive force (8 Hrs)

Electro chemical cell – Daniel cell – Cell reaction – Single electrode potential – statement – explanation of Nernst equation – Standard hydrogen electrode – Calomel electrode – measurement of EMF – determination of pH using Hydrogen electrode – Potentiometric titration – concentration cells.

UNIT VI :Instrumental methods of Analysis(6 Hrs)

Principles of TGA, DTA, AAS, Spectrophotometry, Potentiometric Titration and their Applications

UNIT VII ::Chemistry of Nano Materials (6hrs)

Evolution of Nano science – Historical aspects – preparations containing nano gold in traditional medicine, Lycurgus cup – Faraday's divided metal etc.Nanosystems in nature.Preparation of Nano particles – Top – down approach and bottom – up approach, sol – gel synthesis, colloidal precipitations, Co- precipitation, combustion technique. Properties of nano particles: optical, magnetic and mechanical properties.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks	Unit	Marks
I	10	V	8
II	7	VI	5
III	9	VII	6
IV	7		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistry for Biological Sciences

SEMESTER	COURSE CODE	HOURS	CREDIT	EXAM

		PER WEEK		HRS
III	**3C03PCH/CHE (BS)**	**3**	**2**	**3**

Contact Hrs –54

Course Outcome

On successful completion of this course, students should be able to

CO1) i) Understand the basic concept of Coordination Chemistry, nomenclature, Werner's coordination theory and Valance bond theory of coordination complexes
ii) Write the name of Coordination compounds
iii) Explain Werner's coordination theory and Valance bond theory of coordination complexes
iv) Explain the application of coordination complexes

CO2) i) Understand the electron displacement effects in organic molecules
ii) Explain the mechanism of nucleophilic substitutions and eliminations in alkyl halides
iii)Explain the mechanism of aromatic electrophilic substitution reactions

CO3) i) Classify the isomerism in organic molecules
ii) Distinguish the geometrical isomers and explain their stability
iii) Explain the characteristics of chiral compound
iv) Explain the conformational isomers in alkanes and cycloalkanes

CO 4) i) Explain the important types of polymerization, thermoplastics and thermosetting plastics
ii) Understand the characteristics of biodegradable plastics
CO 5) Understand the basic concept of thermodynamics and laws of thermodynamics
CO6) i) Understand the basic concept of chemical kinetics
ii)Calculate Ea from the values of k at two temperatures
iii) Explain homogeneous catalysis, heterogeneous catalysis and Characteristics of catalysis reactions

UNIT I Co-ordination Chemistry(9 hrs)

Co-ordination compounds and complex ions –co-ordination number - Ligands-types - unidentate, bidentate, polydentate ligands – Werners theory – Nomenclature of co-ordination compounds – Effective Atomic Number Rule, significance – Factors affecting the stability of complex ions – valence bond theory of complexes - application of complexes.

UNIT II : Organic reaction mechanisms (10 hrs)

Classifications of organic reactions – Electron displacement effects- Inductive, Electromeric, Resonance, Hyper conjugative,Steriic effects. Mechanisms of SN_1 and SN_2 reaction.Walden inversion.Elimination reactions – E_1 and E_2 reactions. Addition of hydrohalogen acids – Markownikoff's rule – peroxide effect. Aromatic electrophilic substitution reactions - chlorination, nitration, sulphonation and Friedel Crafts reaction

UNIT III : Stereochemistry (9 hrs)

Isomerism – general – stereoisomerism – optical isomerism – chirality – plane polarized light – specific rotation – enentiomerism – recemization – diastereo isomer – optical activity of lactic acid and tartaric acid – meso tartaric acid – resolution – conformational isomerism – ethane, propane and cyclohexane – chair and boat forms- stability – geometrical isomerism – causes – maleic acid and fumaric acid – 1-butene and 2-butene stability.

UNIT IV : Introduction to Polymer Chemistry (8 hrs.)

Types of polymerization: Chain polymerization, step polymerization – homopolymers and copolymers phenol formaldehyde, urea formaldehyde polymers – Natural rubber and synthetic rubbers – Synthetic fibers– Thermoplastics and Thermosetting plastics – pollution due to plastics – Biodegradable plastics.

UNIT V : Thermodynamics (9 Hrs)

Basic concepts**–** System – surroundings – open, closed and isolated systems – Isothermal – isochoric and isobaric process – work – heat – energy – internal energy – Heat capacity at constant volume (Cv) and at constant pressure (Cp) – relation between Cp and Cv – First law– The second law – Enthalpy-Entropy-and Free energy-Criteria for reversible and irreversible process-Gibbs –Helmholtz equation(no derivation) concepts of spontaneous and non spontaneous processes.

UNIT VI : Chemical kinetics and catalysis (9hrs)

Definition – reaction rate – factors affecting the rate of a chemical reaction – units – Zero order reactions – Order versus molecularity. Pseudo order reactions – Integrated rate equation for first order reaction – half life – Ester hydrolysis – equation. Collision theory (qualitative) Effect of temperature on reaction rate – calculation of Ea from the values of k at two temperatures. Transition state theory (qualitative).Types of catalysis – homogeneous and heterogeneous. Characteristics of catalysis reactions – promoters and catalytic poisons. Activation energy and catalysis.

Distribution of Marks for Complementary Elective Course

<u>Marks including choice</u>:

Unit	Marks	Unit	Marks
I	10	V	9

II	10	VI	9
III	8		
IV	6		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistry for Biological Sciences

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4C04PCH/CHE (BS)	3	2	3

Contact Hrs –54

Course Outcome

On successful completion of this course, students should be able to

CO1) Illustrate the preparatory methods of glucose and fructose and explain their configurations Familiarize the structure and properties of sucrose and poly sachrides

CO2) Know the structure of important five membered and six membered heterocyclic compounds and explain their reactivity and important reactions .Explain the preparation and properties of Quinoline and iso quinoline

CO 3) Understand the structure and functions of neuclic acids , Classify amino acidsand explain the structure of protein and its importance

CO4) Understand the mechanism of enzyme action , enzyme catalysis

CO5) Know the structure of Vitamin A, B and C. and hormones progesterone, Testosterone, cortisone, adrenaline and Thyroxin

CO6) Understand the importance of metal ions in biological systems and Mechanism of O2 and CO_2 transportation – Nitrogen Fixation Na-K pump

UNIT I : Carbohydrates **(9 hrs)**

Introduction – Definition and classification. Preparation and properties of Glucose, Fructose and Sucrose – Mutarotation – Epimers and Anomers.D and L configuration. Conversion of glucose into fructose and fructose into glucose. Canesugar – Structure and important properties – Polysaccharides.Starch, Cellulose and Chitin – structure, properties and tests.

UNIT II : Heterocyclic compounds (10 hrs)

Introduction to Heterocyclic systems (5 membered, 6 membered and condensed systems.) Structure of pyrrole, Furan and Thiophene.Electrophilic substitution in pyrrole, Furan and Thiophene. Reactivity and orientation – Saturated 5 numbered heterocyclics – Structure and properties of pyridine. Electorphilic and nucleophilic substitution reactions in pyridine – Basicity and reduction.Quinoline and isoquinoline – preparation and properties.

UNIT III : Nucleic acids (7 hrs) Classification – Purine and pyrimidine bases - structure of DNA and RNA – Functions of Nucleic Acids – DNA replication –Bio synthesis of Proteins – Test for DNA and RNA. Effect of hydrogen bonding in biologicalsystems.

UNIT IV : Amino acids and proteins (9 hrs)

Classification of Amino acids – Physical and Chemical Properties – Zwitter ions – Iso Electric point – Sorensons formal titration – chromatographic separation of amino acids – Peptides – Proteins classification, characterization by electrolysis – Primary, Secondary and Tertiary level structures of proteins – Tests for Proteins.

UNIT V : Enzymes, Vitamins and Hormones (10 hrs)

Enzymes – General Nature – Mechanism of Enzyme action, Enzyme catalysis, Michaelis – Menten equation (No derivation) – Application of Enzymes, Enzyme deficiency deceases – Vitamins – Classifications structure of Vitamin A, B and C. Hormones – Classification – Structures of progesterone, Testosterone, cortisone, adrenaline and Thyroxine.

UNIT VI : Bio inorganic compounds (9 hrs)

Introduction - Metal ions in biological system – Metals in medicine – metal – nucleic acid interaction – biochemistry of iron – haemoglobin and myoglobin – structure and functions – Mechanism of O2 and CO2 transportation – Nitrogen Fixation Na-K pump – Bio chemistry of Zn Co and Ca in biological system.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks	Unit	Marks
I	10	V	10
II	8	VI	8
III	6		
IV	10		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

References:

1. Inorganic chemistry : Puri and Sharma
2. Inorganic chemistry : P.L.Soni
3. Concise inorganic chemistry : J.D.Lee
4. Basic inorganic chemistry : Cotton and Wilkinson
5. Physical Chemistry : Puri and Sharma
6. Physical Chemistry P.L.Soni and Dharmarah
7. Elements of Physical Chemistry Glasstone and Lewis

8. University Chemistry Bruce M Mahan and Rollie J Myers
9. Basic Physical Chemistry Moore W.J
10. Essentials of Physical Chemistry Bahl,Tuli and Arun
11. Advanced organic Chemistry : Jerry March
12. Organic Chemistry Morrison and Boyd
13. Environmental Chemistry A.K.De
14. Organic Chemistry Vol. 1 and II I.L.Finar
15. Polymer Chemistry Gawarikar and Vishvanadhan
16. Organic reaction mechanism : Peter Sykes
17. Organic reaction mechanism : Mukherjee and Singh
18. Organic photochemistry: Depuy and Chapman
19. Organic Spctroscopy William Kemp
20. Pragathi's Instrumental Methods of Analysis : H.Kaur

SEMESTER I, II, III & IV

4C05 PCH/CHE- COMPLEMENTARY ELECTIVE - CHEMISTRY PRACTICAL

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1) Apply the theoretical concepts while performing experiments.

CO2) Acquire practical skill to estimate acid, base, oxidizing agents etc by volumetric titration method

CO3) Acknowledge experimental errors and their possible sources.

CO 4) Design, carry out, record and analyze the results of chemical experiments

CO5) Acquire practical skill to analyse the anions and cations qualitatively present in a mixture of inorganic salts

CO 6) Learns the effective usage of chemicals

1. Qualitative Inorganic Mixture Analysis

a. Reactions of cations:

Study of the reactions of the following cations with a view of their identification and

confirmation.

Lead, Copper, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Barium, Calcium, Magnesium and Ammonium.

b. Systematic qualitative analysis of a solution containing any two of the cations given in

(a) by semi micro methods.

2. Volumetric Analysis

(a) Introduction to electronic balance and analytical balance - volumetric apparatus -

filtration, Equivalent and molecular mass of compounds - Normality and Molarity - Primary standards - Preparation of standard solution - Principles of Volumetric analysis.

(b.) For acidimetry, alkalimetry and permanganometry two burette method may be used and for other volumetric analyses conventional methods can be used. (Students should prepare standard solutions. The experiments should have the making up of the given solution and double titration in each experiment.

a. Acidimetry and alkalimetry

Estimation of (a) strong acids (b) strong bases (c) weak acids (d) weak bases.

b. Permanganometry

Estimation of (a) Fe2+/FeSo4.7H2O/Mohr's salt (b) Oxalic acid

c. Dichrometry

Estimation of (a) Fe2+ using internal indicator (b) Fe3+ after reduction with stannous chloride/HC1

d. Iodimetry and iodometry

Estimations of (a) copper (b) potassium dichromate and (c) Potassium permanganate.

VIVA VOCE

References

1.	A Text Book of Qualitative Analysis including semi micro methods	A.I.Vogel
2.	Semi micro Qualitative Analysis	V.V.Ramanujan

3.	A Text Book of Quantitative inorganic Analysis	A.I.Vogel
4.	Practical chemistry for B.Sc Chemistr y	A.O.Thomas

MODEL QUESTION COMPLEMENTARY CHEMISTRY PRACTICAL

Time : 4 Hours

Credit: 4 Total 32 marks

1. Identify and confirm the two Cations in the given solution by systematic qualitative analysis. Submit a record of your tests, observation and inferences along with the report.

2. Determine the amount of HNO_3 in the Whole of the given solution You are provided with Pure Crystalline $H_2C_2O_4 .2H_2O$ and Approximately N/10 NaOH Solution.

3. In the first ten minutes,

(a.) Write a brief outline of the procedure you would adopt for the estimation of Copper in the given solution of Copper Sulphate, given With A.R. potassium dichromate and N/10 Sodium thiosulphate.

(b) Calculate the mass of crystalline Copper Sulphate required to prepare 200 ml 0.2 N Solution.

4. Viva Voce

Pattern of Question paper for U.G Core Courses (Polymer Chemistry)-Theory
KANNUR UNINERSITY

Reg. No.: Course code:
Name:

---------Semester

Course title Programme

Total marks: 40

Time: 3hrs.

Answer the questions in English only

Section A

(very short answer type - Each carries 1 mark -Answer all 4 questions)

1. ……

2. . ……

3. . ……

4. . ……

[4x1=4 marks]

Section B

(Short answer type - Each carries 2 mark -Answer 7 questions out of 10)

5. . ……

6. . ……

7. . ……

8. . ……

9. . ……

10. . ……

11. . ……

12. . ……

13. . ……

14. . ……

[7x2=14 marks]

Section C

(Short essay/problem type - Each carries 3 mark -Answer 4 questions out of 6)

15. . ……

16. . ……

17. . ……

18. . ……

19. . ……

20. . ……

[4x3=12 marks]

Section D

(Long essay type - Each carries 5 mark -Answer 2 questions out of 4)

21. . ……

22. . ……

23. ……..

24. . ……

[2 x 5= 10 marks]

Pattern of Question paper for U.G Complementary Courses -Theory

Reg. No.: Course code:

Name:

---------Semester

Course title Programme

Total marks: 32

Time: 3hrs.

write only in English

Section A

(very short answer type - Each carries 1 mark -Answer all 5 questions)

1.

2.
3.
4.
5.

Section B

(Short answer type - Each carries 2 mark -Answer 4 questions out of 6)

6.

7.

8.

9.

10.

11.

Section C

(Short essay type - Each carries 3 mark -Answer 3 questions out of 5)

12.

13.

14.

15.

16.

Section D

(Long essay type - Each carries 5 mark -Answer 2 questions out of 4)

17.

18.

19.

20.

Pattern of Question paper for U.G Generic Elective Course

Reg. No.: Course code:

Name:

---------Semester

Course title Programme

Total marks: 20

Time: 2 hrs.

Answers can be written only in English

Section A

(very short answer type- Each carries 1 mark -Answer all 5 questions)

1.

2.

3.

4.

5.

Section B

(Short answer type - Each carries 2 mark -Answer 3 questions out of 5)

6.

7.

8.

9.

10.

Section C

(Short essay type - Each carries 3 mark -Answer 3 questions out of 5)

11.

12.

13.

14.

15.

Pattern of Question paper for U.G General Awareness Courses (Polymer Chemistry)-Theory

Reg. No.: Course code:
Name:

---------Semester

Course title Programme

Total marks: 32

Time: 3hrs.

Answer the questions in English only

Section A

(very short answer type - Each carries 1 mark -Answer all 5 questions)

1. ……

2. . ……

3. . ……

4. . ……

5.....

[5x1=5 marks]

Section B

(Short answer type - Each carries 2 mark -Answer 4 questions out of 6)

6. . ……

7. . ……

8. . ……

9. . ……

10. . ……

11. . ……

[4x2=8 marks]

Section C

(Short essay/problem type - Each carries 3 mark -Answer 3 questions out of 5)

12. . ……

13. . ……

14. . ……

15. . ……

16. . ……

[3x3=9 marks]

Section D

(Long essay type - Each carries 5 mark -Answer 2 questions out of 4)

17. . ……

18. . ……

19. ……..

20. . ……

[2 x 5= 10 marks]