



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

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.

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



Forwarded/By Order

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SECTION OFFICER



KANNUR UNIVERSITY

BOARD OF STUDIES, CHEMISTRY (UG)

SYLLABUS FOR CHEMISTRY CORE COURSE

COMPLEMENTARY ELECTIVE COURSE AND GENERIC ELECTIVE COURSES

FOR BSc 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 education and 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 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 at 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. Thereference 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.

There are many personalities whose support and guidance made this restructured syllabus a reality. 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 stakeholders who worked for preparing this restructured syllabus and curriculum.

Saheed VK

Chairperson

Board of Studies, Chemistry (UG), Kannur University.

Kannur University**BSc Chemistry Programme****Programme Specific Outcomes (PSOs)**

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

PSO 1 Understand the fundamental concepts, principles and processes underlying the academic field of chemistry, its different subfields (analytical, inorganic, organic and physical), and its linkages with related disciplinary areas/subjects;

PSO 2 Demonstrate procedural knowledge that creates different types of professionals in the field of chemistry and related fields such as pharmaceuticals, chemical industry, teaching, research, environmental monitoring, product quality, consumer goods industry, food products, cosmetics industry, etc.;

PSO 3 Employ critical thinking and the scientific method to design, carry out, record and analyze the results of chemical experiments and get an awareness of the impact of chemistry on the environment and the society.

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 chemistry or a related field, and work in the chemical and non-chemical industry sectors.

PSO5 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 chemical reaction for sustainable development.

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

COURSE STRUCTURE FOR CHEMISTRY (UG) PROGRAMME
2019 ADMISSION

SEMESTER I

No.	Title of the 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	4	4	10	40	50
4	Core Course 1 (Theoretical & Inorganic Chemistry)	2	2	10	40	50
5	Core Course 2 Practical I Part 1	2	-	-	-	-
6	Complementary Elective -I (Course I)	2	2	8	32	40
7	Complementary Elective Practical	2	-	-	-	-
8	Complementary Elective -II (Course I)	4	3	10	40	50
	Total	25	18	58	232	290

SEMESTER-II

No	Title of the 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	4	4	10	40	50
4	Core Course 3 (Analytical and Inorganic chemistry- I)	2	2	10	40	50
5	Core Course 2, Practical I - Part 2	2	3	10	40	50
6	Complementary Elective – I (Course II)	2	2	8	32	40
7	Complementary Elective Practical	2	-	-	-	-
8	Complementary Elective -II (CourseII)	4	3	10	40	50
	Total	25	21	68	272	340

SEMESTER-III

No	Title of the Course	Hours /week	Credit	MARKS		
				CE	ESE	TOTAL
1	English Common Course V	5	4	10	40	50
2	Additional Common Course- III	5	4	10	40	50
3	Core Course4 (Organic Chemistry I)	3	3	10	40	50
4	Core Course 5 Practical 2,Part I	2	-	-	-	-
5	Complementary Elective -I(CourseIII)	3	2	8	32	40
6	Complementary Elective Practical	2	-	-	-	-
7	Complementary Elective -II (CourseIII)	5	3	10	40	50
	TOTAL	25	16	48	192	240

SEMESTER-IV

No	Title of the Course	Hours /week	Credit	MARKS		
				CE	ESE	TOTAL
1	English Common Course VI	5	4	10	40	50
2	Additional Common Course- IV	5	4	10	40	50
3	Core Course 6(Organic Chemistry II)	3	3	10	40	50
4	Core Course 5 Practical 2,Part II	2	3	10	40	50
5	Complementary Elective -I(CourseIV)	3	2	8	32	40
6	Complementary ElectivePractical	2	4	8	32	40
7	Complementary Elective -II (CourseIV)	5	3	10	40	50
	TOTAL	25	23	66	264	330

SEMESTER-V

No	Title of the 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	Title of the 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	3	3	10	40	50
6	Core Course 11& 12 Practical 3& 4	7	6	10+ 10	40+ 40	50+ 50
7	Core Course 13 Project Industrial Visit	1	2	4	16+ 5	25
	TOTAL	25	24	74	301	375

First Complementary Elective –Physics, Second Complementary Elective-Mathematics

Total Credit 120

Total Marks 1800

Scheme of Mark distribution - B Sc Chemistry Programme

Course	No.of Papers	Marks per paper	Total Marks
English Common Course	6	50	300
Additional Common Course	4	50	200
Complementary Elective Course -Physics	5(4 Theory +1Practical)	40	200
Complementary Elective Course -Mathematics	4	50	200
Core Course-Chemistry	17(12Theory +5Practicals)	50	850
Project	1	25	25
Generic Elective Course	1	25	25

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

Programme	Sem.	Common*		Core	Complementary Elective Course		Generic Elective Course	Total
		Eng	Addl	Chemistry	Mathematics	Physics		
BSc (Chemistry)	I	4+3	4	2	3	2		18
	II	4+3	4	2+3	3	2		21
	III	4	4	3	3	2		16
	IV	4	4	3+3	3	2+4		23
	V			4+4+4+4			2	18
	VI			4+3+3+3+3+3+3+2				24
	Total	22	16	56	12	12	2	120

Components of Core (Chemistry)

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

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

Scheme of Core course (Chemistry)

No.	Semester	Course code	Title of the Course	Credits	Contact hr/week
1	I	1B01CHE	Theoretical and Inorganic Chemistry	2	2
2	II	2B03CHE	Analytical and Inorganic chemistry-I	2	2
3	II	1B02CHE/PCH & 2B02CHE/PCH	*Core Course Practical I Volumetric Analysis	3	2—I Sem 2—II Sem
4	III	3B04CHE/PCH	Organic Chemistry-I	3	3
5	IV	4B06CHE/PCH	Organic Chemistry-II	3	3
6	IV	3B05CHE/PCH & 4B05CHE/PCH	*Core Course Practicals 2 Inorganic Qualitative Analysis	3	2—III Sem 2—IV Sem
7	V	5B07CHE/PCH	Analytical and Inorganic chemistry-II	4	3
8	V	5B08CHE/PCH	Inorganic Chemistry	4	3
9	V	5B09CHE/PCH	Physical Chemistry- I	4	3
10	V	5B10CHE/PCH	Physical Chemistry- II	4	3
11	VI	6B14CHE/PCH	Organic Chemistry III	4	4
12	VI	6B15CHE/PCH	Physical Chemistry III	3	4
13	VI	6B16CHE/PCH	Physical Methods in Chemistry	3	3
14	VI	6B17CHE/PCH	Discipline Specific Elective Course	3	3
15	VI	5B11CHE/PCH & 6B11CHE/PCH	*Core Course Practicals 3 Gravimetric Analysis	3	5—V Sem 4—VI Sem
16	VI	5B12CHE/PCH & 6B12CHE/PCH	*Core Course Practicals 4 Organic Chemistry	3	5---V Sem 3---VI Sem
17	VI	6B18CHE/PCH	*Core Course Practicals5 Physical Chemistry	3	3
18	VI	5B13CHE/PCH & 6B13CHE/PCH	Project & Industrial Visit	2	1—SemV 1---Sem VI

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

Scheme for Discipline Specific Elective Course

No	Semester	Course code	Title of the course	Contact hour/Week	Credit
1	VI	6B17CHE/PCH-A	Environmental Chemistry	3	3
2	VI	6B17CHE/PCH-B	Applied Chemistry	3	3
3	VI	6B17CHE/PCH-C	Polymer Chemistry	3	3
4	VI	6B17CHE/PCH-D	NanoChemistry	3	3

Scheme for Complementary Elective Course (Chemistry)

No	Semester	Course code	Title of the course	Contact hour/week	Credit
1	I	1C01CHE/PCH	Chemistry (For Physical & Biological Sciences)	2	2
2	II	2C02CHE/PCH	Chemistry (For Physical & Biological Sciences)	2	2
3	III	3C03CHE/PCH(BS)	Chemistry (For Biological Science)	3	2
4	III	3C03CHE/PCH(PS)	Chemistry (For Physical Science)	3	2
5	IV	4C04CHE/PCH(BS)	Chemistry (For Biological Science)	3	2
6	IV	4C04CHE/PCH(PS)	Chemistry (For Physical Science)	3	2
5	I,II, III&IV	4C05CHE*/PCH	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 Chemistry Programme. External examination will be conducted at the end of Vth semester.

Options available for Generic Elective course (Chemistry)

No	Semester	Course code	Title of the course	Contact hour/ week	Credit
1	V	5D01CHE/PCH	Chemistry in Service to man	2	2
2	V	5D02CHE/PCH	Drugs-Use & Abuse	2	2
3	V	5D03CHE/PCH	Environmental Studies	2	2
4	V	5D04CHE/PCH	Nanomaterials	2	2
5	V	5D05CHE/PCH	Chemistry in Every day 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, whereas 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

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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 (Chemistry) 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 (Chemistry)

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

Table 3: Internal and External marks for Generic Elective Course (Chemistry)

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

Marks including choice:

Unit	Marks

Table 7. Type of questions & Marks for External Examination - Core Chemistry

	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
Marks including choice:

Unit	Marks

Table 8. 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 9. 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
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 VIth semester.
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 of the aggregate and 40% separately for ESE and 10% CE 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	1B01CHE	2	2	3

Course outcome

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

CO 1: Correlate the structure and behavior of atom

CO2: Differentiate the various chemical interactions in molecules through bonding concepts

CO3: Analyze and interpret the gradation in the properties of elements in the periodic table

CO4: Predict the nuclear transmutations

CO5: identify the role of radioactive materials in different applications

Contact hours-36**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- Heisenberg'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 (9hrs)

Ionic 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 electronegativity. Radius ratio – Effective nuclear charge – Screening effect – Slater rules, Anomalous behaviour of 1st element of a group – diagonal relationship.

UNIT:4 NUCLEAR CHEMISTRY(9HRS)

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.

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 Press 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

Distribution of Marks for External Examinations**Marks including choice:**

Unit	Marks
I	19
II	17
III	10
IV	16

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

	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 III : ANALYTICAL AND INORGANIC CHEMISTRY – I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	2B03CHE	2	2	3

Course Outcome

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: Summarize the characteristics of s- and p- block elements

CO 5: Compare the various concepts of acids and bases

Contact hours-36**Unit:I Theoretical Aspects of Analytical Chemistry (7hrs)**

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(6hrs)

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, –

Permanganometry, dichrometry-redox indicators,

iodometry-iodimetry. Indicators – theory of adsorption indicators – complexometric titrations- EDTA titrations-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 behavior of second period element in the following groups of elements-Group 13 (B, Al, Ga, In and Tl).

Group 14 (C, Si, Ge, Sn and Pb) Group 15 (N, P, As, Sb and Bi). Group 16 (O, S, Se, Te and Po) and Group 17 (F, Cl, Br and I).

Unit: IV Acids and Bases (9hrs)

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.

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

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	13
II	12
III	23
IV	14

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

	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
III	3B04CHE/PCH	3	3	3

Course Outcome

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) Distinguish aromatic, anti aromatic and nonaromatic compounds and ions and analyse the mechanistic details of aromatic electrophilic substitution

CO:3) Classify stereo isomers, understand the property of chirality, apply CIP rules to recognize the configuration and explain the stability of 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

Contact 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 S_n axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric 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	15	V	5
II	10	VI	9
III	16		
IV	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 VI: ORGANIC CHEMISTRY – II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
1V	4B06CHE/PCH	3	3	3

Course Outcome

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

CO :1) 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.

CO :2) Explain Chugaev and Cope eliminations and $E1CB$ mechanism

CO :3) Illustrate the preparative methods and important properties of Hydro carbons, halogen compounds, Hydroxy compounds and Carbonyl Compounds

CO: 4) Explain the mechanism of important name reactions including rearrangements involving hydroxyl and Carbonyl functional groups

Contact hours 54

UNIT I- MECHANISM OF ORGANIC REACTIONS (12 HOURS)

Substrate and reagent- Electrophiles and nucleophiles- Aliphatic nucleophilic substitutions- mechanism of S_N1 , S_N2 - 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 $E1$ versus $E2$ reactions and on the relative rates substitution versus elimination.

$E1CB$ mechanism- Thermal elimination reactions- Chugaev 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 II - 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 alkyl halides, dehalogenation of vic dihalides and by Kolbe's electrolytic method.

Reactions- Hydrogenation, addition of halogens, halogen acid and water. Oxidation with KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$ 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 $\text{K}_2\text{Cr}_2\text{O}_7$ and Selenium dioxide, 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; $\text{S}_{\text{N}}\text{Ar}$ 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° , 2° and 3° 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, Rieme-Tiemann reaction, Hauben-Hoesch reaction, Gattermann-Koch reaction ,

FeCl_3 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, Oppenauer oxidation, Houben - Hoesch synthesis. Reactions of aldehydes and ketones. Reduction using LiAlH_4 and NaBH_4 MPV,

[Type text]

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, Claisen-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	Unit	Marks
I	14	V	16
II	15		
III	5		
IV	12		

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

	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	5B07CHE/PCH	3	4	3

Course Outcome

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 :4Explain the classification of refractories.

CO :5Knowthe position, electronic configuration and physical properties of noble gases and explain hybridization and geometry of different xenon compounds

CO :6Explain 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.

[Type text]

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 – B_2H_6 and B_4H_{10} (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— XeF_2 , XeF_4 , XeF_6 , XeO_2F_2 , $XeOF_2$, $XeOF_4$ and XeO_3 .

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 .Corrosion 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	11	V	10
II	11	VI	9
III	11		
IV	10		

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

	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 CHE/PCH	3	4	3

Course Outcome

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. Transition 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 ININORGANIC CHEMISTRY (4Hrs)

New elements in periodic table :Elements with atomic numbers-113,115,117,118. -Note on discovery and naming of these elements
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.

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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/>
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6. <https://www.geopolymer.org/science/introduction/>
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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	15	V	10
II	11	VI	2
III	13		
IV	11		

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

	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 CHE/PCH	3	4	3

Course outcome

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

CO1) Recognize and relate the properties of ideal and real gases

CO2) Describe the properties of liquids.

CO3) Identify and distinguish the types of solutions

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

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 by capillary rise method and by using stalagmometer – 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.

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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 Debye 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 defects-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 Berkeley 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

[Type text]

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 - Core Chemistry

	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 CHE/PCH	3	4	3

Course outcome

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

CO 1) Identify the fundamental concepts of thermodynamics

CO2) Relate and Interpret the various laws of thermodynamics

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) Correlate the types of colloids with its properties and to explore the applications in day today life.

Contact hrs 54**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 C_v and constant pressure C_p – relation between C_p and C_v 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 q_v and constant pressure q_p – relation between q_p and q_v – Hess's law and its

applications – bond energy calculations – variation of enthalpy change of a reaction with temperature – Kirchhoff 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 constant (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 K_p , K_c and K_x – Thermodynamic treatment of the law of mass action – Vant Hoff reaction isotherm – Temperature dependence of the equilibrium constant – The Van't Hoff's isochore – Pressure dependence of the equilibrium constant K_p – 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 K_p . Heterogeneous equilibria – Dissociation of solid calcium carbonate and decomposition of solid NH_4HS .

UNIT 4 Phase Rule (10 hrs)

Statement of phase rule 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 --- simple 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 Na_2SO_4 water system. – solid-gas equilibria -- decomposition of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$. – 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 $\text{KI} + \text{I}_2 = \text{KI}_3$.

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 – Donnan 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 Currie
11. Physical chemistry by G W Castellan.

Distribution of Marks for External Examinations

Marks including choice:

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

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

	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 XIV: ORGANIC CHEMISTRY - III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B14CHE/PCH	4	4	3

Course Outcome

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

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; Interconversion of Monosaccharides: Aldopentose to Aldohexose (Arabinose to D- Glucose, D- Mannose) (Killiani - Fischer method). Epimers, Epimerisation – Aldohexose to Aldopentose (D- Glucose to D- Arabinose) by Ruff degradation. Aldohexose to Ketohexose [(+) Glucose to (-) Fructose] and Ketohexose to Aldohexose (Fructose to Glucose)

Structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation. Colour tests for carbohydrates

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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, Phthalicacids, 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, Electrophilic substitution, Nucleophilic substitution.

Cyanides and isocyanides- Nomenclature - General methods of preparation.

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

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

UNIT IV AMINO ACIDS, PROTEINS AND NUCLEIC 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 - Preparation, 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 - PHARMACEUTICAL COMPOUNDS: (7 HOURS)

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 - Hoffmann 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.

[Type text]

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

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

	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 XV: PHYSICAL CHEMISTRY - III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B15CHE/PCH	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 conductometric titrations

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

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

CO 4) Familiarise with electro analytical methods

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

CO6) Understand basic principles of photochemistry and its application in spectrophotometry

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.

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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 disadvantages.potentiometric titration – redox indicators — Fuel cells. (hydrogen-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 (16 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-their derivation (first order only). 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 (7hrs)

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 - Instrumentation of photocolormeter -applications

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	V	6
II	8		
III	20		
IV	14		

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

	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 XVI: PHYSICAL METHODS IN CHEMISTRY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B16CHE/PCH	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, δ and 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 simple 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 – C_{nv} , C_{nh} , H_2O , NH_3 , N_2O_4 , N_2F_2 .

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
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 Leuwers-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 - Core Chemistry

	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	6B17CHE/PCH- 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 treatment of 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, Hydrosphere, 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, NO_x, SO₂, H₂S, Hydrocarbons, particulate matter.

Acid rain and its effects.

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

[Type text]

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 resources, - 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 waste management

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 Vol. II, Gurdeep Raj
6. Engineering Chemistry, Dr. B.K. Sharma
7. Engineering Chemistry, Jain & Jain, Dhanpat Rai Publishing Company

[Type text]

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		

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

	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	6B17CHE/PCH- B	3	3	3

Course Outcomes :

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

CO-1 Explain 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 assessment-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

[Type text]

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		

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

	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	6B17CHE/PCH- 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

CO2) Illustrate the preparation, properties and applications of polymers

CO3) Interpret the mechanism of polymerization

CO4) Acquaint various polymer processing technologies and explain thermal methods of analysis of polymers

CO5) 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 (T_g) - Definition- Factors affecting T_g - relationships between T_g and molecular weight and melting point. Importance of T_g.

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

Preparation, properties and applications of - Plastics: Polyethylene, Polyvinylchloride, polymethyl methacrylate, polyethylene terephthalate, 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 –

[Type text]

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. Billmeyer, *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

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

	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	6B17CHE/PCH - 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. Feynmans 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-TiO₂, ZnO; Organic nano systems- dendrimers, Metal nano particles-quantum dots.

UnitII 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 Solvothormal synthesis, Microemulsion or Reverse micelle synthesis. Microwave synthesis, Electrochemical method. Biological synthesis using plant extract and microorganism.Molecular self assembly.

UnitIII.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.

UnitIV 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, Nanoscience 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

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

	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 I & II**

**CORE COURSE PRACTICAL I (1B02CHE/PCH& 2B02CHE/PCH)
Volumetric Analysis**

72 hrs/ credit 3

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) 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 $\text{HCl}/\text{H}_2\text{SO}_4/\text{HNO}_3$ 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 SnCl_2 - internal indicator

4 Iodometry And Iodimetry

[Type text]

- a. Estimation of Cu^{2+} / $\text{CuSO}_4 \cdot \text{H}_2\text{O}$.
- b. Estimation of potassium dichromate.
- c. Estimation of $\text{As}_2\text{O}_3/\text{As}^{3+}$

5 Precipitation titration-using adsorption indicators

Estimation of chloride in neutral medium

6 Complexometry

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

Inorganic Preparation

- a. Ferrous ammonium sulphate.
- b. Potash alum.
- c. Tetraammine copper(II) sulphate.
- d. Potassium trisoxalato chromate.

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

SEMESTER III& IV**(3B05CHE/PCH& 4B05CHE/PCH) Inorganic Qualitative Analysis**

Credit 3

72hrs

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 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 qualitative 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**5B11 CHE /PCH & 6B11 CHE/PCH : GRAVIMETRIC ANALYSIS**

Credit:3

Course Outcome**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: Acquire practical Knowledge of co-precipitation

CO4: Handle sintered glass vessels

CO5) Acknowledge experimental errors and their possible sources.

CO6 Able 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.

SEMESTER V & VI**5B12 CHE/PCH & 6B12 CHE/PCH : ORGANIC CHEMISTRY**

Credit:3

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 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, toluidines, 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 R_f 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

6B18CHE/PCH ` PHYSICAL CHEMISTRY

CREDIT: 3

Hrs/week: 3

Course Outcome**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.

salt hydrates: $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ / $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$. 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

[Type text]

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 $KMnO_4$, determination of the concentration of the given solution.

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

9. Surface tension –Measurement using Stalagmo meter

Note:

1. A minimum number of 8 experiment 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 Qualitative Analysis including semi-micro methods
2. V.V.Ramanujan - Semi micro Qualitative Analysis.
3. A.I.Vogel - A Text Book of Quantitative Inorganic Analysis.
4. A.I.Vogel - Elementary Practical Organic Chemistry.
5. A.O.Thomas - Practical Chemistry for B.Sc Chemistry.
6. A Findlay - Practical Physical Chemistry.
7. R.C.Das & E Behara - Experimental Physical Chemistry.
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 (6th Semester).

PROJECT REPORT:

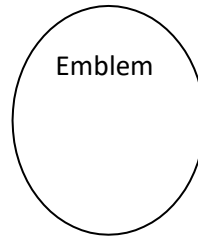
PROJECT CO 1) Able to enhance the skills of managing the resources, time and team work.

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

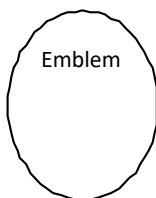
Students should undertake a group project work related to chemistry and submit the report along with practical records during VI semester practical.

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 the 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 (Chemistry)

By

Name of Student

Reg No

Name & Designation of project guide

Signature, Name & Designation of Head of the department

Examiners:

1)

2)

Page I : Certificate (By Project Guide)

Page 2. Declaration (By Student)

Page 3. Acknowledgement

Page 4 . Contents

[Type text]

Chapter I : Introduction

Chapter II : Aim of the project/Problem Statement

Chapter III : Review

Chapter IV : The Study/Present work

Chapter V : Data Analysis/ Discussion

Chapter VI :Conclusion

Bibliography

MODEL QUESTION PAPERS FOR PRACTICALS**B.Sc CHEMISTRY PRACTICAL EXAMINATION
SEMESTER 11-****1B02CHE/PCH& 2B02CHE/PCH 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 andcrystals.
4. Exhibit the samples of inorganic complexes prepared
5. Viva Voce

SEMESTER IV**PRACTICAL II :****3B05CHE/PCH& 4B05CHE /PCH 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 5B11CHE/PCH& 6B11CHE/PCH

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 ofin the whole of
the givenSolution.
- 3 Viva Voce

SEMESTER VI 5B12CHE/PCH& 6B12CHE /PCH

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 functional group present in it and submit a report of the procedure adopted.
Suggest a suitable solid derivative for the compound and write the procedure for
its preparation..
3. Convert the giveninto..... Recrystallise
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: 6B18CHE/PCH PHYSICAL CHEMISTRY**

Time : 4 Hours

Credit : 3

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

Attempt the question marked X

1. Determine the molecular 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	5D01CHE/PCH	2	2	2

Contact hours:36Hrs

Course Outcome

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

CO1) i) Understand the 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.

[Type text]

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 ofordinary 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 indispensable 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	5D02CHE/PCH	2	2	2

Contact hours:36Hrs

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 routes 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- Routes of drug administration, Enteral, parenteral and topical routes. Bioavailability of drugs -Advantage and disadvantage of various routes of administration-

PHARMACOKINETICS

(10HRS)

Definition of Pharmacokinetics- 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 .Antibiotics- Discovery and its importance. Examples of antibiotics - Antibiotic misuse .Antihistamines- 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 examples and effects, Depressants, Hallucinogens examples and effects, Sedatives, 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	5D03CHE/PCH	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, NO_x, Sox, Hydrocarbons, Particulates. Effect

on ecosystem., Ozone layer –importance, Ozone depletion-Control measures- Acid rain-

control of 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

[Type text]

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 Pollution 8 Hours

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

heavy metals. Poisoning by heavy metals – Minamata and 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 – Erach Bhar
2. Essential Environmental studies- S. P. Misra – S. N. Pandey
3. Environmental chemistry and pollution control – S.S Dara (2nd 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	5D04CHE/PCH	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	5D05CHE/PCH	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 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

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

COMPLEMENTARY ELECTIVE COURSE**Chemistry for Physical & Biological Sciences**

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	1C01CHE/PCH	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

[Type text]

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. pH and 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 K_w and K_h for salts of strong acid – weak base, weak acid – strong base and weak 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	2C02CHE/PCH	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 Photosensitization, 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, tropylium 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 K_c , K_p and K_x - thermo dynamic

derivation of chemical equilibrium. Liquid systems – Le-Chatlier's Principle – Effects of temperature, pressure and concentrations.

[Type text]

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	3C03CHE/PCH(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 , nomenclature and applications of coordination complexes,

Illustrate the valence 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 E_a 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

[Type text]

constant volume (C_v) and at constant pressure (C_p) – relation between C_p and C_v – 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 E_a 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	4C04CHE/PCH(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 behavior and Maxwell distribution of velocities and 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 colligative 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 .

[Type text]

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 PER WEEK	CREDIT	EXAM HRS
III	3C03CHE/PCH (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 Valence bond theory of coordination complexes

ii) Write the name of Coordination compounds

iii) Explain Werner's coordination theory and Valence 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 E_a 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, Steric 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 – enantiomerism – racemization – 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 (C_v) and at constant pressure (C_p) – relation between C_p and C_v – 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 E_a 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

Marks including choice:

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	4C04CHE /PCH (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 polysaccharides

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 nucleic acids , Classify amino acids and 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 Thyroxine

CO6) Understand the importance of metal ions in biological systems and Mechanism of O₂ and CO₂ 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. Cane sugar – 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 membered heterocyclics – Structure and

[Type text]

properties of pyridine. Electrophilic 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 biological systems.

UNIT IV : Amino acids and proteins

(9 hrs)

Classification of Amino acids – Physical and Chemical Properties – Zwitter ions – Iso Electric point – Sorenson's formal titration – chromatographic separation of amino acids – Peptides – Proteins classification, characterization by electrophoresis – 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 diseases – 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 Spectroscopy William Kemp
20. Pragathi's Instrumental Methods of Analysis : H.Kaur

SEMESTER I, II, III & IV**4C05 CHE/PCH- 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) $\text{Fe}^{2+}/\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ /Mohr's salt (b) Oxalic acid

c. Dichrometry

Estimation of (a) Fe^{2+} using internal indicator (b) Fe^{3+} after reduction with stannous chloride/ HCl

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	A.I.Vogel
2.	Semi micro Qualitative Analysis	V.V.Ramanujan
3.	A Text Book of Quantitative inorganic	A.I.Vogel
4.	Practical chemistry for B.Sc Chemistry	A.O.Thomas

MODEL QUESTION COMPLEMENTARY CHEMISTRY PRACTICAL

Time : 4 Hours

Credit: 4 Total 32 marks

- 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.
- Determine the amount of HNO_3 in the Whole of the given solution You are provided with Pure Crystalline $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ and Approximately N/10 NaOH Solution.
- In the first ten minutes,
 - 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.
 - Calculate the mass of crystalline Copper Sulphate required to prepare 200 ml 0.2 N Solution.
- Viva Voce

Pattern of Question paper for U.G Core Courses (Chemistry)-Theory
KANNUR UNINERSITY

Reg. No.:

Name:

------(Semester)(Programme)

.....(Course code).....(Course title)

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]

[Type text]

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 (Chemistry)-Theory

Reg. No.:

Name:

----- (Semester) (Programme)

..... (Course code) (Course title)

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)

[Type text]

- 17.
- 18.
- 19.
- 20.

Pattern of Question paper for U.G Generic Elective Course

Reg. No.:

Name:

------(Semester)(Programme)

.....(Course code).....(Course title)

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.

[Type text]

