Maharaja's College Ernakulam

A GOVERNMENT AUTONOMOUS COLLEGE

Re-Accredited by NAAC with 'A Grade'
Affiliated to Mahatma Gandhi University
Centre of Excellence under Govt. of Kerala
Identified by UGC as College with Potential for Excellence

POST GRADUATE AND RESEARCH

DEPARTMENT OF CHEMISTRY

Estd. 1875

Under Graduate Curriculum and Syllabus

(Choice Based Credit Semester System)

B.Sc. CHEMISTRY

For 2020 Admission Onwards

MAHARAJA'S COLLEGE, ERNAKULAM
(A Government Autonomous College)

UNDER GRADUATE PROGRAMME

IN

CHEMISTRY (Model I)

2020

Programme Code: MCUSCCH06

Regulation Curriculum and Syllabus

FOREWORD

The Board of Studies in Chemistry take this opportunity to express our deep appreciation to all academicians and professionals who participated in the workshops organized by the Board for restructuring curriculum and syllabi of the UGcourses in Chemistry - B.Sc Chemistry Model I and B. Sc. Chemistry (Environment and Water Management). We express our profound gratitude to the Honourable Vice-Chancellor, Pro-Vice Chancellor and our special thanks are due to the Chairman and members of the Governing Council, Chairman and members of the Academic Council, Maharaja’s College, Ernakulam. We also extend our gratitude to Prof. (Dr). K. Girish Kumar, Professor, Department of Applied Chemistry, Cochin University of Science and Technology, Dr. M.R Prathapachandra Kurup, Professor and Head, Department of Chemistry, Central University of Kerala Dr. Kochubaby Manjooran, Dy. Manager (Energy and Envt), BPCL, Kochi Refinery, Dr. T. Narayanan, Associate Professor (Retd.), Maharaja’s College, Ernakulam, who were entrusted with the responsibility as experts for the revision of the syllabus of different subjects. The Board of Studies in Chemistry expresses the wholehearted gratitude to all those who have helped in this endeavour.

The task of preparing the curricula and syllabi and bringing it out in the present form for all the B. Sc courses was not simple but it was possible with dedicated efforts and wholehearted support and involvement of all the members of the BOS and the faculty members of the Department of Chemistry. I would like to express my sincere thanks to all my fellow members of BOS and the faculty members of the Department of Chemistry for all their help, cooperation, encouragement, active participation and useful suggestions for the completion of syllabus.

Chairman
Board of Studies

Maharaja's College, Ernakulam
(A Government Autonomous College)
Affiliated to Mahatma Gandhi University, Kottayam
Under Graduate Programme in Chemistry 2020 Admission Onwards

Board of Studies in Chemistry 2019-2020

Sl.No.	Name of Member	Designation
1.	**Sri. Ashokan K. P.**	Chairman, BoS Chemistry
2.	**Prof. (Dr). K. Girish Kumar**	External Member (Subject Expert)
3.	**Dr. M.R Prathapachandra Kurup**	External Member (Subject Expert)
4.	**Dr. Kochubaby Manjooraan**	External Member (Industry)
5.	**Dr. T. Narayanan**	External Member (Alumni)
6.	**Dr. Meera Gopal**	Internal Member
7.	**Smt. Femina K. S.**	Internal Member
8.	**Dr. Bindu Sharmila T. K.**	Internal Member
9.	**Dr. Amrutha S. Rajan**	Internal Member
10.	**Dr. Sreesha Sasi**	Internal Member
11.	**Dr. Jolly V. Antony**	Internal Member

MAHARAJA'S COLLEGE, ERNAKULAM
(A GOVERNMENT AUTONOMOUS COLLEGE)

REGULATIONS FOR UNDER GRADUATE PROGRAMMES
UNDER CHOICE BASED CREDIT SYSTEM 2020

1. TITLE

1.1. These regulations shall be called "**MAHARAJA'S COLLEGE (AUTONOMOUS) REGULATIONS FOR UNDER GRADUATE PROGRAMMESUNDER CHOICE BASED CREDIT SYSTEM 2020**"

2. SCOPE

2.1 Applicable to all regular Under Graduate Programmes conducted by the Maharaja's College with effect from 2020 admissions

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

2.3 The provisions herein supersede all the existing regulations for the undergraduate programmes to the extent herein prescribed.

3. DEFINITIONS

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

3.2. **'*Choice Based Course*'** means a course that enables the students to familiarize the advanced areas of core course.

3.3. ***'College Coordinator'*** is a teacher nominated by the College Council to co-ordinate the continuous evaluation undertaken by various departments within the college. He/she shall be nominated to the college level monitoring committee.

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

3.5 ***'Common Course II'*** means additional language.

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

3.6. ***'Core course'*** means a course in the subject of specialization within a degree programme. It includes a course on environmental studies and human rights.

3.7. ***'Course'*** means a portion of a subject to be taught and evaluated in a semester (similar to a paper under annual scheme).

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

3.9. ***'Department'*** means any teaching department in a college.

3.10. ***'Department Coordinator'*** is a teacher nominated by a Department Council to co- ordinate the continuous evaluation undertaken in that department.

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

3.12. ***'Faculty Advisor'*** means a teacher from the parent department nominated by the Department Council, who will advise the student on academic matters.

3.13. ***Grace Marks*** shall be awarded to candidates as per the University Orders issued from time to time**.**

3.14. ***'Grade'*** means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a Paper/Course/ Semester/Programme.

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

3.16. ***'Parent Department'*** means the department which offers core course/courses within an undergraduate programme.

3.17. ***'Programme'*** means a three-year programme of study and examinations spread over six semesters, the successful completion of which would lead to the award of a degree.

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

3.19. ***'Vocational Course'* (Skill Enhancement Course)** means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

4.1 Eligibility for admissions and reservation of seats for various Undergraduate Programmes shall be according to the rules framed by the University/ State Government in this regard, from time to time.

5. DURATION

5.1 The duration of U.G. programmes shall be ***6 semesters***.

5.2 There shall be two Semesters in an academic year, the "ODD" semester commences in June and on completion, the "EVEN" Semester commences. There shall be two months' vacation during April and May.

5.3 No student shall be allowed to complete the programme by attending more than 12 continuous semesters.

6. REGISTRATION

6.1. The strength of students for each programme shall be as per the existing orders, as approved by the University.

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

7. SCHEME AND SYLLABUS

7.1. The U.G. programmes shall include **(a)** Common Courses I and II, **(b)** Core Course(s), **(c)** Complementary/Vocational Courses, and **(d)** Choice based course**.**

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

7.3. Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The

Credit Transfer Scheme shall allow students pursuing a programme in one college to continue their education in another college without break.

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

7.5. Students discontinued from previous regulations CBCSS 2016, can pursue their studies under the new regulation "Regulations for Under Graduate Programmes under Choice Based Credit System 2020" after obtaining readmission.

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

8. PROGRAMME STRUCTURE (Model I B Sc)

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	22
d	Credits required from Common Course II	16
e	Credits required from Core course and Complementary courses including Project	75
f	Choice Based Core Course	7
g	Minimum attendance required	75%

PROGRAMME STRUCTURE (Model III B Sc)

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	8
d	Credits required from Core + Complementary + Vocational Courses including Project	105
e	Choice based Course	7
f	Minimum attendance required	75%

9. EXAMINATIONS

9.1 The evaluation of each paper shall contain two parts:

i. Internal or In-Semester Assessment (ISA)
ii. External or End-Semester Assessment (ESA)

9.2. The internal to external assessment ratio shall be 1:4.
Both internal and external marks are to be rounded to the next integer.

All papers (theory & practical), grades are given **on a 7-point scale** based on the total percentage of marks, ***(ISA+ESA)*** as given below:-

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

10. CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a paper is calculated using the formula:-

CP = C × GP, where C is the Credit and GP is the Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula:-

SGPA = TCP/TC, where TCP is the Total Credit Point of that semester.

Cumulative Grade Point Average (CGPA) is calculated using the formula:-

CGPA = TCP/TC, where TCP is the Total Credit Point of that programme.

Grade Point Average (GPA) of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational course, Core Course is calculated using the formula:-

GPA = TCP/TC, where TCP is the Total Credit Point of a category of course.

TC is the total credit of that category of course

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

GPA	**Grade**
9.5 and above	**S Outstanding**
8.5 to below 9.5	**A+ Excellent**
7.5 to below 8.5	**A Very Good**
6.5 to below 7.5	**B+ Good**
5.5 to below 6.5	**B Above Average**
4.5 to below 5.5	**C Satisfactory**
3.5 to below 4.5	**D Pass**
Below 3.5	**F Failure**

11. MARKS DISTRIBUTION FOR EXTERNAL AND INTERNAL EVALUATIONS

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

11.1 For all courses without practical

1.a) Marks of external Examination : 80

1.b) Marks of internal evaluation : 20

Components of Internal Evaluation of theory	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**5**
Test papers (2x5=10)(Marks of test paper shall be average)	**10**
Total	**20**

11.2 For all courses with practical total marks for external evaluation is 60 and total marks for internal evaluation is 15.

For all courses with practical

2.a) Marks of external Examination : 60

2.b) Marks of internal evaluation : 15

Components of Internal Evaluation	**Marks**
Attendance	**5**
Seminar/Assignments/Viva	**2**
Test paper (2x4)	**8**
Total	**15**

c. For practical examinations total marks for external evaluation is 40 for internal evaluation is 10

Components of Internal Evaluation (Practicals)	**Marks**
Attendance	**2**
Test (1x4)	**4**
Record*	**4**
Total	**10**

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

11.3 Project Evaluation

Components of Project evaluation	Marks
Internal Evaluation*	20
Dissertation (end semester)	50
Viva Voce(end Semester)	30

Components of Project Internal evaluation

Components of internal evaluation	Marks
Relevance and Contents	5
Analysis and Presentation	5
Presubmission Presentation and viva	10

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

All three components of internal assessments are mandatory.

11.4 For projects

2.c) Marks of external evaluation : 80

2.d) Marks of internal evaluation : 20

c)

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

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

Components of internal Evaluation of Project	Marks
Punctuality	5
Experimentation/data collection	5
Knowledge	5
Report	5
Total	**20**

Attendance Evaluation for all papers

% of attendance	Marks
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

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

12. ASSIGNMENTS

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

13. SEMINAR/VIVA

A student shall present a seminar in the 5th semester for each paper and appear for Viva-voce in the 6th semester for each course.

14. INTERNAL ASSESSMENT TEST PAPERS

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

14.1 Grievance Redressal Mechanism

Internal assessment shall not be used as a tool for personal or other type of vengeance. A student has all rights to know, how the teacher arrived at the marks. In order to address the grievance of students, a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: Department Level:

The Department cell chaired by the HOD, Department Coordinator, Faculty Advisor and Teacher in-charge as members.

Level 2: **College level**

A committee with the Principal as Chairman, College Coordinator, HOD of concerned Department and Department Coordinator as members.

The College Council shall nominate a Senior Teacher as coordinator of internal evaluations. This coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of I semester

14.2 The internal evaluation marks/grades in the prescribed format should reach the Controller of Examination before the 4th week of October and March in every academic year.

15. External Examination

The external theory examination of all semesters shall be conducted by the Controller of Examinations at the end of each semester.

15.1 Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the subcommittee of the college council on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the **semester** along with the next batch after obtaining readmission upon the recommendations of the head of the department and college council

15.2 All students are to do a **project in the area of core course.** This project can be done individually or in groups (not more than three students). for all subjects which may be carried out in or outside the campus. The projects are to be identified during the V semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the College.

15.3 There shall be supplementary exams only for fifth semester. Notionally registered candidates can also apply for the said supplementary examinations. For reappearance/ improvement for other semesters the students can appear along with the next batch.

15.4 A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.

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

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

16. All courses shall have unique alphanumeric code.

17. PATTERN OF QUESTIONS

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

Pattern of questions Papers

(a) Without practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	Short Answer/problem type	2	10/12	20
2	Short essay/problem	5	6/9	30
3	Essay/problem	15	2/4	30
			Total	80

(b) With practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	Short Answer/problem type	1	10/12	10
2	Short essay/problem	5	6/9	30

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

Each BOS shall specify the length of the answers in terms of number of words. Pattern of questions for external examination of practical papers will decided by the concerned Board of Studies/Expert Committees.

18. MARK CUM GRADE CARD

The College shall issue to the students a MARK CUM GRADE CARD on completion of the programme.

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

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

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

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

UNDERGRADUATE PROGRAMME OUTCOMES (POs)

After successfully completing any three-year under graduate program, a student is expected to achieve the following attributes.

1. **Information value**. Solid, comprehensive and updated information on the discipline concerned help the students gain perceptive insights into the subject, pursue higher studies, enhance employment potential and land in a job at good time

2. **Scientific temper and critical thinking.** Mindset which enables one to follow a way of life that focuses upon the scientific method of understanding reality and the capability to think rationally and reflectively.

3. **Inclusiveness**. Constant exposure to and interaction with disparate social strata for an inclusive mindset, ethical sensibility and greater social sensitivity and empathy.

4. **Democratic practice and secular outlook**. As envisioned by the Constitution of India.

5. **Sense of equality, equity and environment**. Ability to differentiate between pure equality, social equity and a heightened awareness of how humans dialectically interact with environment.

6. **Synergetic work culture**. Capacity to work in groups and the attitude to consider larger goals greater than personal ones.

7. **Emancipatory and transformative ideals**. Attainment of cherished ideals of education for the eventual empowerment of humanity.

UNDERGRADUATE PROGRAMME IN CHEMISTRY
(MODEL-I AND MODEL III)
PROGRAMME SPECIFIC OUTCOMES (PSOs)

It is expected that after successfully completing under graduate programme in Chemistry, a student is expected to achieve the following:

1. A strong foundation in chemistry that stresses scientific reasoning and analytical problem-solving skills.
2. Understand the various experimental techniques using modern instrumentation.
3. Skills to gather information from various interdisciplinary subjects in chemistry and to integrate knowledge of mathematics, physics and other disciplines to a wide variety of chemical problems.
4. Learn the laboratory skills needed to design, safely conduct and interpret chemical research.
5. Acquire a foundation of chemistry by referring modern Information technology resources and databases.
6. Develop the ability to effectively communicate scientific information and research results in written and oral formats.
7. Gain latest knowledge in field of chemistry and make them prepared for pursuing higher education in chemistry
8. Learn professionalism, including the ability to work in teams and apply basic ethical principles.
9. Develop an eco-friendly attitude by creating a sense of environmental awareness.

SYLLABUS
FOR
B.Sc. CHEMISTRY

CREDIT AND MARK DISTRIBUTION IN EACH SEMESTER

B.Sc. CHEMISTRY -DETAILED SCHEME

	Code	Course	Hours/ week	Credit	Marks		
					Internal	External	Total
Semester 1	ENG1CMR01	Common Course- English	5	4	20	80	100
	ENG1CMR02	Common Course- English	4	3	20	80	100
		Additional Language	4	4	20	80	100
	CHE1COR01	Inorganic Chemistry - I (General Inorganic Chemistry)	2	2	15	60	75
	CHE2P01	Volumetric Analysis Practical	2	-	Evaluation at the end of second semester		
	MAT1CMP01	Complementary mathematics	4	3	20	80	100
	PHY1CMP01	Complementary Physics	2	2	15	60	75
	PHY2CP01	Complementary Physics Practical	2	-	Evaluation at the end of second semester		
	Total		**25**	**20**			**550**
Semester 2	ENG2CMR03	Common Course- English	5	4	20	80	100
	ENG1CMR04	Common Course- English	4	3	20	80	100
		Additional Language	4	4	20	80	100
	CHE2COR02	Inorganic Chemistry –II (Atomic Structure, Chemical Bonding and Basic Coordination Chemistry)	2	2	15	60	75
	CHE2P01	Volumetric Analysis Practical	2	2	10	40	50
	MAT2CMP02	Complementary mathematics	4	3	20	80	100
	PHY2CMP02	Complementary Physics	2	2	15	60	75
	PHY2CP01	Complementary Physics Practical	2	2	10	40	50
	Total		**25**	**20**			**650**

Semester 3	ENG3CMR05	Common Course- English	5	4	20	80	100
		Additional Language	5	4	20	80	100
	CHE3COR03	Organic Chemistry -1 (Reaction Mechanism & Stereochemistry)	3	3	15	60	75
	CHE4P02	Organic Chemistry Practical –I	2	-	Evaluation at the end of fourth semester		
	MAT3CMP03	Complementary mathematics	5	4	20	80	100
	PHY3CMP03	Complementary Physics	3	3	15	60	75
	PHY4CP02	Complementary Physics Practical	2	-	Evaluation at the end of fourth semester		
	Total		**25**	**20**			**450**
Semester 4	ENG4CMR06	Common Course- English	5	4	20	80	100
		Additional Language	5	4	20	80	100
	CHE4COR04	Organic Chemistry –II (Functional Group Chemistry)	3	3	15	60	75
	CHE4P02	Organic Chemistry Practical–I	2	2	10	40	50
	MAT4CMP04	Complementary Mathematics	5	4	20	80	100
	PHY4CMP04	Complementary Physics	3	3	15	60	75
	PHY4CP02	Complementary Physics Practical	2	2	10	40	50
	Total		**25**	**20**			**550**
Semester 5	CHE5COR05	Environmental Studies and Human Rights	3	3	20	80	100
	CHE5COR06	Organic Chemistry-III (Natural Products)	3	3	15	60	75
	CHE5COR07	Physical Chemistry- I (States Of Matter And Surface Chemistry)	2	2	15	60	75
	CHE5COR08	Physical Chemistry- II (Quantum Mechanics, Spectroscopy And Photochemistry)	3	3	15	60	75
	CHE5CBP01	Choice Based Course - I	4	4	20	80	100

	CHE6P03	Qualitative Inorganic Analysis	3	-	Evaluation at the end of sixth semester		
	CHE6P04	Organic Chemistry Practical- II	2	-	Evaluation at the end of sixth semester		
	CHE6P05	Physical Chemistry Practical	3	-	Evaluation at the end of sixth semester		
	CHE6D01	Project	2	-	Evaluation at the end of sixth semester		
	Total		**25**	**20**			**425**
Semester 6	CHE6COR09	Inorganic Chemistry – III (Advanced Inorganic Chemistry)	3	3	15	60	75
	CHE6COR10	Organic Chemistry- IV (Advanced Organic Chemistry)	3	3	15	60	75
	CHE6COR11	Physical Chemistry – III (Thermodynamics And Kinetics)	3	3	15	60	75
	CHE6COR12	Physical Chemistry – IV (Solution Chemistry And Electrochemistry)	3	3	15	60	75
	CHE6CBP01	Choice Based Course - II	3	3	20	80	100
	CHE6P03	Qualitative Inorganic Analysis	3	2	10	40	50
	CHE6P04	Organic Chemistry Practical- II	2	2	10	40	50
	CHE6P05	Physical Chemistry Practical	3	2	10	40	50
	CHE6P06	Gravimetric Analysis	2	2	10	40	100
	CHE6D01	Project and Viva		2	20	80	100
	Total		**25**	**20**			**750**

SEMESTER 1

CHE1COR01 – INORGANIC CHEMISTRY – I

(GENERAL INORGANIC CHEMISTRY)

Total Hrs: 36; Credits: 2; Hrs/Week: 2; Total Marks 75 (Internal 15 & External 60)

CHE1COR01	**INORGANIC CHEMISTRY – I (GENERAL INORGANIC CHEMISTRY)**	L*	T**	P ***	C#
		2	0	0	2
Objectives	To make the student to understand that Chemistry is a basic science subject and have major relation to other branches of science. Students will also gain better insights on the basic principles of qualitative and quantitative analyses and the periodic properties of elements.				
Course Outcome(s)					
CO1	The course will enable the student to understand the methodology of Science in general and Chemistry in particular				
CO2	This course will give foundations on the periodic properties of elements				
CO3	Make the student a good experimentalist based on understanding of fundamental analytical principles and good laboratory practices				
CO4	To inculcate skills required for qualitative and quantitative inorganic analysis				

*Lecture, **Tutorial, ***Practical, #Credit

Module 1: Methodology of Chemistry (9 Hrs)

Types of knowledge: Practical, theoretical and scientific knowledge. Definition of science. Scientific statements, Scientific methods – Hypothesis – theories and laws in science – observations, evidences and proofs, Scientific problem- induction, deduction. Falsicication of hypothesis. Revision of scientific theories and laws- (Atomic theory as example- Democrates, Dalton, J. J Thomson, Rutherford, Sommerfield, Bohr and Quantum mechanical theory). Evolution of chemistry ancient speculation on the nature of matter- early form of chemistry- origin of modern chemistry, structure of chemical science – scope, theory and experiment.Branches of chemistry- Role of chemistry as a central science connecting physics, biology and other branches of science. Basic ideas of interdisciplinary areas involving chemistry-nano technology, biotechnology biochemistry, nuclear chemistry, analytical chemistry, environmental chemistry, combinatorial chemistry, medicinal chemistry, engineering chemistry.

Module 2: Chemistry of s and p block elements (9Hrs)

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

2.2 Compounds of p block elements: Boron hydrides –diborane (preparation, properties and bonding), Classification- Closo, Nido and Arachno - B_5H_9, B_4H_{10} (structure only). Closo carboranes, boron nitride, borazine, boric acid.Peroxy acids of sulfur. Oxides and oxy acids of halogens (structure only), superacids, interhalogen compounds, pseudohalogens, electropositive iodine, fluorocarbons. Fluorides, oxides and oxy fluorides of xenon (structure only).

Module 3: Chemistry of d and f block Elements (9 Hrs)

3.1. General characteristics of d-block elements with special reference to electronic configuration, oxidation states, metallic character, color, magnetic properties, catalytic properties and ability to form complexes. Comparison of the properties of second and third transition series with first transition series.

3.2. Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties, spectral properties and separation of lanthanides by ion exchange and solvent extraction methods (Brief study).

3.3. Chemistry of actinides – electronic configuration, oxidation states, actinide contraction, position of actinides in the periodic table, comparison with lanthanides in terms of magnetic properties and spectral properties (Brief study).

Module 4: Analytical Principles (9 Hrs)

4.1. Laboratory hygiene & safety-storage and handling of chemicals. Simple first aids: electric shocks, fire, cut glass, inhalation of poisonous gases, accidents due to acids and alkalies, burns due to phenol and bromine. Disposal of sodium and broken mercury thermometer – use of $CaCl_2$ & Silica gel in desiccators. Awareness of material safety data sheet (MSDS). R&S (elementary idea only). Good Laboratory Practices- Laboratory sign.

4.2. Inorganic qualitative analysis - Common ion effect, solubility product –Principle, Applications of solubility product and common ion effect in the precipitation of cations, principle and procedure of Interfering acid radicals and their elimination (oxalate, fluoride, borate, phosphate, chromate, arsenite and arsenate). Titrimetric Analysis: Molecular mass, Equivalent mass, Primary and secondary standards, quantitative dilution – problems standard solutions, Normality, molarity, molality mole fraction, ppm and ppb and related problems. Theory of titrations involving acids and bases, titration curves, $KMnO_4$, $K_2Cr_2O_7$. Indicators – Theory of acid-base, redox, adsorption indicators. Complexometric Titrations, EDTA titrations- titration curves metal ion indicators (basic theory and principle only).

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SEMESTER I

PROGRAMME: B.Sc. CHEMISTRY

CHE1COR01 – INORGANIC CHEMISTRY – I

(GENERAL INORGANIC CHEMISTRY)

Module	**Hrs Allotted**	**Part A 1 Mark (10/12)**	**Part B 5 Marks (6 / 9)**	**Part C 10 Marks (2 / 4)**	**Total questions**
1	9	3	3	1	**7**
2	9	3	2	1	**6**
3	9	3	2	1	**6**
4	9	3	2	1	**6**
	36	12	9	4	**25**

MODEL QUESTION PAPER

BSc DEGREE (C.B.C.S.S) EXAMINATION

First Semester

Core Course: Chemistry

CHE1COR01 – INORGANIC CHEMISTRY – I

(General Inorganic chemistry)

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

PART A (Answer any 10 questions)

1. What is meant by hypothesis?
2. What is a scientific law?
3. What is medicinal chemistry?
4. What is meant by inert pair effect?
5. What are inter-halogen compounds? Give one example
6. Give the structure of XeO_2F_2
7. Why are d-block elements known as transition elements?
8. What type of electronic transitions is dominant in transition elements?
9. Why ion-exchange methods are appropriate for separation of lanthanides?
10. What is MSDS?
11. Define common ion effect
12. Name any two adsorption indicators **(10 × 1=10 Marks)**

PART B (Answer any 6 questions)

13. Explain the inductive and deductive methods of reasoning
14. Write a note on Rutherford and Bohr models of atomic structure
15. What is falsification of hypothesis? Explain with an example
16. Write a short note on (a) boron nitride and (b) borazine
17. Explain the periodic trends of ionization energy and electron affinity of s and p-block elements
18. How do first row transition elements differ from second and third row series in terms of magnetic properties and ability to form complexes?
19. Explain the effects of (a) lanthanide contraction and (b) actinide contraction
20. Write a short note on Good Laboratory Practices
21. Explain the principle of EDTA based complexometric titrations.

(6 × 5 = 30 Marks)

PART C (Answer any 2 questions)

22. Is chemistry 'The Central Science'? How are different sciences related?
23. Discuss the preparation, properties and bonding of diborane (B_2H_6).
24. Make a thorough comparison between actinides and lanthanides in terms of electronic configuration, oxidation states, magnetic and spectral properties.
25. Discuss about disposal methods of sodium and broken mercury thermometer. How do you eliminate interfering anions fluoride and phosphate in qualitative inorganic analysis?

(2 $\times$10 = 20 Marks)

SEMESTER 2

CHE2COR02: INORGANIC CHEMISTRY –II

(ATOMIC STRUCTURE, CHEMICAL BONDING AND BASIC COORDINATION CHEMISTRY)

Total Hrs: 36; Credits: 2; Hrs/Week: 2; Total Marks: 75 (Internal 15 &External 60)

CHE2COR02	INORGANIC CHEMISTRY –II (ATOMIC STRUCTURE, CHEMICAL BONDING AND BASIC COORDINATION CHEMISTRY)	L	T	P	C
		2	0	0	2
Objectives	To introduce the students to the emergence of quantum theory based models to explain the atomic structure and chemical bonding. One module is devoted for a thorough understanding of various theoretical models for describing the shape and bonding of molecules and metals. Another module is designed for acquiring basic concepts of coordination chemistry, naming of complexes, structure as well as their stereochemistry.				
Course Outcome(s)					
CO1	This course gives the student the salient features of the quantum mechanical model of the atom.				
CO2	This course gives the student to acquaint with different types of bonds and different types of hybridization and other useful theories of bonding				
CO3	At the end of the course the students will able to familiarize with different weak intra and inter molecular forces				
CO4	This course gives a thorough understanding the basic ideas of coordination compounds				
CO5	Enable the students to understand the isomerism in metal complexes				
CO6	Provides the knowledge of basic theories of coordination compounds				

Module 1: Atomic Structure (9 Hrs.)

Bohr model of hydrogen atom, Bohr's equation for the energy of electron in hydrogen atom, derivation of Bohr radius, velocity, energy of hydrogen atom, the hydrogen spectrum, limitations of Bohr theory. Photoelectric effect, idea of de Broglie matter waves, Heisenberg's uncertainty principle and its significance, Schrodinger wave equation (derivation not expected), wave functions, significance of Ψ and Ψ^2. Operators - Laplacian and Hamiltonian operators. Atomic orbitals, nodal planes in atomic orbitals, quantum numbers (n, l, m). Zeeman effect, Stern- Gerlac experiment, spin quantum number (s). Shapes of s, p and d orbitals. Aufbau and Pauli's exclusion principles, Hund's rule, energy level diagram of a multi electron atom. Concept of effective nuclear charge, Slater's rules and applications.Electronic configuration of atoms.

Module 2: Chemical Bonding (18 Hrs.)

2.1. Ionic bond – nature of ionic bond, properties of ionic compounds, radius ratio and coordination number, factors favoring the formation of ionic compounds. Lattice energy, Born Lande equation with derivation, factors affecting lattice enthalpy, Born-Haber cycle and its applications, solvation enthalpy and solubility of ionic compounds.

2.2. Covalent bond- valence bond theory and its limitations, concept of resonance, resonance energy, hybridisation and shapes of simple molecules (BeF_2, PCl_3, PCl_5, SF_6, CH_4, NH_3, BF_3, H_2O, NH_4^+ and IF_7 ethane, ethene and ethyne), VSEPR theory, shapes of molecules and ions (NH_3, CCl_4, H_2O, SF_6, XeF_2, XeF_4, XeF_6, ClF_3, NH_4^+, H_3O^+). Molecular orbital theory – LCAO method, molecular orbital energy diagram and properties of homo and hetero diatomic molecules (H_2, He_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, CO and NO), comparison of bond strength and bond energy and magnetic behavior of O_2, O_2^+, O_2^{2+}, O_2^- and O_2^{2-}. Polarisation of covalent bond, polarizing power and polarisability of ions, Fajan's rule.Dipole moment and molecular structure – percentage of ionic character from dipole moment.

2.3. Metallic bonding – free electron theory, valence bond theory and band theory, explanation of weak chemical forces – hydrogen bond, inter and intra molecular hydrogen bonds, effects of hydrogen bonding, van der Waals forces- ion-dipole, dipole-dipole, ion –induced dipole, dipole – induced dipole and induced dipole- induced dipole interactions.

Module 3: Coordination Chemistry (9 Hrs.)

Coordination complex, ligands and their classification, IUPAC nomenclature, coordination number, geometry of complexes with coordination numbers 4 and 6. Stability of complexes - factors affecting the stability of metal complexes.Chelates, chelate effect, stepwise stability constant and overall stability constant. Isomerism in coordination compounds – structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers. Bonding theories –Werner's theory of coordination, EAN, Valence bond theory, geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations.

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SEMESTER II

PROGRAMME: B.Sc. CHEMISTRY

CHE2COR02: INORGANIC CHEMISTRY –II

(ATOMIC STRUCTURE, CHEMICAL BONDING AND BASIC COORDINATION CHEMISTRY)

Module	Hrs. Allotted	Part A 1 Mark (Answer any 10 questions out of 12)	Part B 5 Marks (Answer any 6 questions out of 9)	Part C 10 Marks (Answer any 2 questions out of 4)	Total questions
1	9	3	2	1	6
2	18	6	5	2	13
3	9	3	2	1	6
	36	12	9	4	**25**

MODEL QUESTION PAPER

BSc DEGREE (C.B.C.S.S) EXAMINATION

Second Semester

Core Course: Chemistry

CHE2COR02: INORGANIC CHEMISTRY – II

(Atomic Structure, Chemical Bonding and Basic Coordination Chemistry)

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

PART A (Answer any 10 questions)

1. Write down the time-independent Schrodinger wave equation
2. Give the de Broglie matter wave equation
3. Write the electronic configuration of chromium (Z = 24).
4. Define lattice energy
5. What is the hybridization of N-atom in NH_4^+ and NH_3?
6. Give an example for a system having intra molecular hydrogen bonding
7. What is meant by polarization of covalent bond?
8. Arrange O_2, O_2^+, and O_2^{2+} in the order of bond strength
9. What is Fajan's rule?
10. Calculate the EAN of $Fe(CN)_6]^{3-}$
11. What is meant by chelate effect?
12. Give the IUPAC naming of (a) $[CoCl(NH_3)_5]Cl$ and (b) $K_2[PdCl_4]$

(10 × 1 = 10 Marks)

PART B (Answer any 6 questions)

13. Explain Slater's rule and its application
14. Write a short note on Stern-Gerlac experiment
15. Using VSEPR theory explain the shape of (a) XeF_4 and (b) CIF_3
16. Write short note on (a) Dipole moment and (b) Polarization of covalent bond
17. Give a short note on van der Waals forces
18. Discuss the hybridization scheme of PCl_3 and IF_7
19. What is LCAO method? Discuss the MO scheme of CO molecule.
20. Explain the geometry of a six-coordination complex on the basis of VB theory
21. Explain the various factors affecting the stability of metal complexes

(6 × 5 = 30 Marks)

PART C (Answer any 2 questions)

22. Derive an equation for the energy of an electron in hydrogen atom
23. (a) Derive the Born Lande equation (b) Explain Born-Haber cycle
24. Explain the free electron theory and band theory of metals
25. Discuss about the types of isomerism in co-ordination complexes

(2 × 10 = 20 Marks)

SEMESTERS 1 & 2

PRACTICAL:CHE2P01 - VOLUMETRIC ANALYSIS

Total Hrs: 36+36=72; Credits: 2; Hrs/Wk: 2; Total Marks 50 (Internal 10 &External 40)

CHE2P01	**VOLUMETRIC ANALYSIS PRACTICAL**	L	T	P	C
		0	0	2	2
Objectives	Experimental practice of quantitative volumetric analysis. To determine the amount of a substance in a given sample. To get familiarize with the concept of concentration of solutions				
Course Outcome(s)					
CO1	To develop skills for quantitative estimation using the different branches of volumetric analysis.				
CO2	To facilitate the students to make solutions of various molar concentrations.				

General Instructions

1. Use safety coat, goggles, shoes and gloves in the laboratory.
2. For weighing electronic balance may be used.
3. Double titration method may be used for volumetric titrations
4. Experiments may be selected in such a way that preference may be given for Modules I and II.
5. A minimum number of, two experiments from module III.
6. A total of 14 experiments must be done from Modules I to V to appear for the examination.
6. Practical examination will be conducted at the end of semester II.

I. Acidimetry and alkalimetry

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

II. Permanganometry

1. Estimation of Ferrous iron
2. Estimation of Oxalic acid
3. Estimation of Hydrogen Peroxide
4. Estimation of Calcium

III. Dichrometry

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

IV. Iodometry and Iodimetry

1. Standardisation of thiosulphate using KIO_3, electrolytic copper and potassium dichromate.
2. Estimation of As_2O_3 and arsenite.
3. Estimation of Cu in a copper salt.

V. Complexometry

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

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SCHEME OF VALUATION

PRACTICAL: CHE2P01 - VOLUMETRIC ANALYSIS

No.	Mark Division	Total marks
1	Presenting data- 3 Calculation- 2 Accuracy upto 1%- 24 Marks (1.6-2 : Deduct 1 mark for each 0.1 % 2.1-2.5 :Deduct 2 mark for each 0.1 % Above 2.5% : 8 marks)	**29**
2	Principle-1 Procedure-3	**4**
3	Molecular mass and Equation- 1 Substitution and Result-1	**2**
4	Viva Voce	**5**

MODEL QUESTION PAPER

PRACTICAL: CHE2P01 - VOLUMETRIC ANALYSIS

Time: 3 Hrs. **Total Marks: 40**

1. Estimate volumetrically the mass of ……………. in the whole of the given solution. You are supplied with an approximately ……………. solution of …………… and pure ……….. crystals. (29 Marks)
2. Write the principle and procedure for the estimation as required in Q.1 (4 Marks)
3. Calculate the mass of ………….. you have to weigh out accurately to prepare ………….. ml of ….. solution for Q.1 (2 Marks)
4. Viva voce (5 Marks)

(Submit answer 2 and 3 within 10 minutes.)

SEMESTER 3

CHE3COR03– ORGANIC CHEMISTRY -1

(REACTION MECHANISM & STEREOCHEMISTRY)

Total Hrs: 54; Credits: 3; Hrs/Week: 3; Total Marks 75 (Internal 15 & External 60)

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CHE3COR03	ORGANIC CHEMISTRY -1 (REACTION MECHANISM & STEREOCHEMISTRY)	L	T	P	C
		3	0	0	3
Objectives	To enable the students to analyze basic theory and concepts of organic chemistry and appreciate different organic reaction mechanism and their stereochemistry.				
Course Outcome(s)					
CO1	To understand the classification and nomenclature of organic compounds,.				
CO2	To understand the fundamentals of organic reaction mechanisms				
CO3	To know about stereochemistry in organic compounds				
CO4	To appreciate the stability of aromatic systems and their reaction mechanisms				

Module 1: Basic concepts of reaction mechanism (18 Hrs)

1.1 ***Classification and nomenclature of organic compounds***

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

1.2 ***Fundamentals of organic reaction mechanism***

Meaning of reaction mechanism: Curved arrow notation. Half headed and double headed arrows.

Electron displacement effects: inductive, inductomeric, electromeric, mesomeric, hyper conjugation and steric effects.

Nature of bond fission: Homolysis and Heterolysis. Types of reagents– Electrophiles and Nucleophiles.

Reactive intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes (structure, formation and stability).

Types of organic reactions: Definition and at least one example of each – substitution, addition, elimination and rearrangement.

Aliphatic nucleophilic substitutions: Mechanisms of S_N1 and S_N2. Effect of substrate, solvent, nucleophile and leaving groups.Stereochemistry- Walden inversion.

Elimination Reactions: Hoffmann and Saytzeff rules, cis and trans eliminations, mechanisms of E1 and E2 reactions. Elimination versus substitution.

Addition reactions: Addition of halogens and hydrogen halides. Mechanisms of addition of Br_2 and hydrogen halides to double bonds- Markownikoff's rule and peroxide effect. Test for unsaturation - Bromine water, Bromine in CCl_4 and Baeyer's reagent. 1,4 - addition in butadienes.

Module 2: Stereochemistry **(18 Hrs)**

2.1 Stereoisomerism - definition - classification into optical and geometrical isomerism

2.2 Optical isomerism - Optical activity - optical and specific rotations - conditions for optical activity - asymmetric centre - Elements of symmetry, chirality - achiral molecules - Projection formulae - Fischer, flying wedge, sawhorse and Newman projection formulae. Meaning of (+) and (-) - notation of optical isomers –D, L notation- Cahn-Ingold-Prelog rules – R,S notations for optical isomers with one and two asymmetric carbon atoms - erythro and threo representations. Enantiomers, Optical isomerism in glyceraldehyde, lactic acid and tartaric acid - Diastereomers - Meso compounds.

2.3 Racemisation - methods of racemisation (by substitution and tautomerism) - Resolution – methods of resolution (mechanical, seeding, biochemical and conversion to diastereoisomers) - Asymmetric synthesis (partial and absolute synthesis). Enantiomeric excess.

2.4 Geometrical isomerism - Cis-trans, syn-anti and E-Z notations - geometrical isomerism in maleic and fumaric acids and unsymmetrical ketoximes - methods of distinguishing geometrical isomers using melting point, dipole moment, dehydration and cyclisation.

2.5 Conformational analysis - Introduction of terms - conformers, configuration, dihedral angle, torsional strain - Conformational analysis of ethane and n-butane including energy diagrams. Origin of ring strain in cyclic systems- Baeyer's starin theory, Cycloalkanes- relative stabilities. Conformers of cyclohexane (chair, boat and skew boat forms) - axial and equatorial bonds- ring flipping showing axial equatorial interconversions, conformation of methylcyclohexane.

Module 3: Aromaticity **(18 Hrs)**

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

3.2 Benzene: Molecular orbital picture and resonance energy. Preparation of benzene from phenol, by decarboxylation, from acetylene and from aromatic acids.

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

3.4 Aromatic nucleophilic substitutions- bimolecular displacement mechanism-Addition-elimination mechanism (S_NAr mechanism) and Elimination – addition mechanism (Benzyne mechanism).

3.5 Polynuclear hydrocarbons: - Classification. Molecular orbital picture and resonance energy of naphthalene and anthracene. Preparation, reactions- electrophilic substitution (halogenations, nitration and sulfonation) of naphthalene.

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SEMESTER III

PROGRAMME: B.Sc. CHEMISTRY

CHE3COR03– ORGANIC CHEMISTRY -1

(Reaction Mechanism & Stereochemistry)

Module	Hrs Allotted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	4	3	1	8
2	18	4	3	1	8
3	18	4	3	2	9
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Third Semester

Core Course: Chemistry

CHE3COR03– ORGANIC CHEMISTRY -1

(Reaction Mechanism & Stereochemistry)

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

PART A (Answer any 10 questions)

1. Give one example each for conjugated and isolated dienes
2. Draw the structure of maleic and fumaric acid
3. Applying Huckel's rule write whether Tropylium cation is aromatic or nonaromatic
4. Define Walden inversion
5. What is dihedral angle in conformational analysis
6. Write two examples for meta directing group
7. Define Hoffmann rule for elimination reaction
8. Write the intermediate obtained when a bond undergoes homolytic fission
9. Draw the structure of two nonbenzenoid aromatic compounds
10. Write any two elements of symmetry.
11. Give reason for the optical inactivity of meso tartaric acid
12. Which is more reactive naphthalene or benzene?Why

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Write the mechanism of halogenation and sulphonation of benzene
14. Briefly explain the conformational analysis of n-butane
15. What are the factors which effect aliphatic nucleophilic substitution reaction?Explain
16. Write the structure and formation of carbocation and carbanion
17. Explain benzyne mechanism
18. Hydroxyl group is ortho and para directing and nitro group is meta directing.Explain using resonance
19. Explain briefly the methods used to distinguish between geometrical isomers
20. Give brief account of asymmetric synthesis and resolution
21. With the help of molecular orbital theory explain the structure and bonding in benzene

(6x5=30 Marks)

PART C (Answer any 2 questions)

22 a) Explain stereochemistry of tartaric acid

b) Explain the conformational analysis of cyclohexane

23. Explain various electron displacement effects.

24 Write the structure and reactions of naphthalene anthracene and phenanthracene

25. Explain the aromaticity shown by benzenoid and nonbenzenoid compounds

(2x10=20 Marks)

SEMESTER 4

CHE4COR04 - ORGANIC CHEMISTRY –II
(FUNCTIONAL GROUP CHEMISTRY)

Total Hrs: 54; Credits: 3; Hrs./Wk: 3; Total Marks 75 (Internal 15 & External 60)

CHE4COR04	ORGANIC CHEMISTRY –II (FUNCTIONAL GROUP CHEMISTRY)	L	T	P	C
		3	0	0	3
Objectives	To give the students a thorough knowledge about the chemistry of some selected functional groups with a view to develop proper aptitude towards the study of organic compounds and their reactions.				
Course Outcome(s)					
CO1	To learn the chemistry of alcohols, phenols, carboxylic acids, derivatives of carboxylic acids, sulphonic acids, carbonyl compounds, poly nuclear hydrocarbons, active methylene compounds, synthetic reagents and Grignard reagents.				
CO2	To understand and study organic reaction mechanisms.				
CO3	To develop skills required for the qualitative analysis of organic compounds				

Module I: Hydroxy Compounds, Ethers and Organometallics (18 Hrs)

1.1. Hydroxy compounds (10 Hrs)

Mono, di and trihydric alcohols- Monohydric alcohols:- Classification, classical methods of preparation of methanol and ethanol, physical properties. Distinction between primary, secondary and tertiary alcohols- Ascend and descend in alcohol series, chemistry of methanol poisoning, harmful effects of ethanol on human body.

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

Trihydric alcohols: Glycerol- synthesis (from fats), reaction with HI, oxalic acids, oxidation.

Phenols: – Acidity of phenols- effects of substituents – comparison of acidity with alcohols. Reaction of phenol with $FeCl_3$, Formation of phenolphthalein and azo dyes.Preparation and uses of nitrophenols, picric acid, catechol, resorcinol and quinol, Mechanisms of Reimer –Tiemann reaction, Lederer- Mannase reaction, Fries Rearrangement.Liebermann's nitroso reaction.

1.2. Ethers and Epoxides (4 Hrs**)**

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

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

1.3. Organometallic compounds (4 Hrs)

Grignard reagents-formation, structure and synthetic applications, alkyl lithium, Organo Zinc compounds, Reformatsky reaction.

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

2.1 Aldehydes, Ketones **(14 Hrs)**

Structure and reactivity of the carbonyl group - acidity of alpha hydrogen.Comparative studies of aldehydes and ketones, aliphatic and aromatic aldehydes, formaldehyde and acetaldehyde.Addition and condensation reactions of carbonyl compounds with HCN, ROH, $NaHSO_3$, Grignard reagents and ammonia derivatives.Mechanisms of nucleophilic additions to carbonyl groups - Aldol, Claisen, Claisen-Schmidt, Benzoin, Perkin, Knoevenagel condensations, Cannizzaro's reaction.

Wittig reaction, Mannich reaction (mechanisms needed). Oxidation reactions- Tollen's and Fehling's tests, Iodoform test, Baeyer-Villiger oxidation (mechanism needed). Reduction reactions- Clemmensen, Wolff-Kishner, Meerwein-Ponndorf-Verley reduction, $LiAlH_4$ and $NaBH_4$ reductions (with mechanisms).

2.2 Compounds containing active methylene groups **(4 Hrs)**

Synthetic uses of malonic ester, acetoacetic ester and cyanoacetic ester.Keto-enol tautomerism.

Module 3: Carboxylic and sulphonic acids and synthetic reagents (18 Hrs)

3.1 Carboxylic and Sulphonic acids **(15 hrs)**

Structure of carboxylate ion- effects of substituents on acid strength of aliphatic carboxylic acids- ascent and descent in fatty acid series, Arndt-Eistert synthesis (Wolff rearrangement to be mentioned), Hell-Volhard- Zelinsky reaction, Kolbe's electrolysis.

Preparation of functional derivatives of carboxylic acids- acid chlorides, esters, anhydrides and amides. Comparative study of the nucleophilicity of acyl derivatives.

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

Preparation, reactions and uses of benzene sulphonic acid, benzene sulphonyl chloride and ortho and para toluene sulphonyl chlorides.

3.2 Synthetic reagents **(3 Hrs)**

NBS, Lead tetra acetate, Periodic acid, OsO_4, Selenium dioxide, MCPBA, DCC (elementary idea)

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SEMESTER IV

PROGRAMME: B.Sc. CHEMISTRY

CHE4COR04 - ORGANIC CHEMISTRY –II

(Functional Group Chemistry)

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	4	3	1	8
2	18	4	3	2	9
3	18	4	3	1	8
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fourth Semester

Core Course: Chemistry

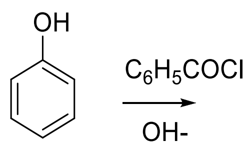
CHE4COR04 - ORGANIC CHEMISTRY –II

(Functional Group Chemistry)

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

PART A (Answer any 10 questions)

1. Out of phenol and a primary alcohol which is more acidic and why?
2. How will you convert ethanol into methanol?
3. How is Zeisel's method useful in the detection of alkoxy group?
4. $H_2C{=}\underset{H}{C}{-}CHO \xrightarrow{LiAlH_4}$
5. Complete the reaction



6. What is Kolbe's electrolysis reaction?
7. What is Hofmann's reaction?
8. Name the reagent used in MPV reduction.
9. What is NBS?
10. Write the product obtained when antharanilic acid undergoes decarboxylation
11. Draw the structure of the product obtained when cyclopentanone undergo Baeyer-Villiger oxidation
12. Name the product obtained when aldol undergoes dehydration

(10x1 = 10 Marks)

PART B (Answer any 6 questions)

13. What is Reformatsky reaction? Explain with mechanism.
14. Carryout the following conversions.

    (a) Benzaldehyde into Cinnamic acid (b) Glycerol into citric acid.
15. Explain why the chloral hydrate and Ninhydrate although gem-diols are stable
16. Write the method of preparation and explain the basicity of Guanidine.

17. Explain why an electron donating group in Claisen –Schmidt reaction decreases the rate of reaction whereas electron withdrawing group enhances the rate of reaction
18. Write the mechanism of Arndt-Eistert reaction
19. What is Benzoin condensation? Explain with mechanism.
20. Write the mechanism of pinacol- pinacolone rearrangement
21. Write the method of preparation of picric acid catechol and resorcinol

(6x5 = 30 Marks)

PART C (Answer any 2 questions)

22. Briefly explain the synthetic utility of compounds containing active methylene groups.
23. Explain the following reactions with mechanism. (a) Claisen rearrangement (b) Perkin condensation.
24. (a) Explain briefly the acid and base catalyzed ring opening reactions of ethers.
    (b) Write a note on Crown ethers and applications in organic synthesis.
25. Write equation for the preparation of
    (i) Adipic acid(ii) Malonic acid
    (iii) Malic acid (iv) Maleic acid

(2x10 = 20 Marks)

SEMESTER 3& 4

PRACTICAL:CHE4P02- ORGANIC CHEMISTRY PRACTICAL –I

Total Hrs: 36+36= 72; Credits: 2; Hrs/Week: 2; Total Marks 50 (Internal 10 & External 40)

CHE4P02	**ORGANIC CHEMISTRY PRACTICAL –I**	L	T	P	C
		0	0	2	2
Objectives	To get training for systematic qualitative analysis of simple organic compounds.				
Course Outcome(s)					
CO1	To develop skills required for the qualitative analysis of organic compounds and determination of physical constants				
CO2	To impart the students a thorough knowledge about the chemistry of some selected functional groups and to study the reactions of organic compounds.				

1. Tests for elements: Nitrogen, Halogens and Sulphur (Green technique may also be adopted).
2. Tests for unsaturation
3. Tests for aromatic character.
4. Study of the reactions of the following functional groups: alcohol, phenol, aldehyde, ketone, carboxylic acid, 1,2- dicarboxylic acid, ester, primary, secondary and tertiary amines, amide, nitro and halogen compounds, diamide, anilide, polynuclear hydrocarbons, reducing and non-reducing sugars.
5. Systematic analysis of the following organic compounds containing one functional group and characterization with its physical constant (solid and liquid) and a derivative :- alcohol, phenol, aldehyde, ketone, carboxylic acid, 1,2 dicarboxylic acid, ester, primary,secondary and tertiary amines, amide, nitro and halogen compounds, diamide, anilide, polynuclear hydrocarbons, reducing and non-reducing sugars.

(Minimum 8 compounds to be analyzed, Chemistry of the reaction is necessary)

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1. A.I. Vogel, B.S. Furniss, Vogel's Textbook of Practical Organic Chemistry, Longman, 1989
2. F.G. Mann and B. C. Saunders, Practical Organic Chemistry, 4thEdn., Pearson Education, 2009.
3. V.K. Ahluwalia and S. Dhingra, Comprehensive Practical Organic Chemistry, Universities Press, 2004.

SCHEME OF VALUATION
CHE4P02- ORGANIC CHEMISTRY PRACTICAL –I

1. Analyze the given organic compound qualitatively. Write down the systematic analysis of the given compound with twoidentification and confirmation tests [30 Marks]

   Preliminary tests : 1
   Detection of Elements : 5
   (Sodium fusion extract: 2; Nitrogen detection: 1; Halogen detection: 1; Sulphur detection: 1)
   Aromatic/Aliphatic : 1
   Saturated/ Unsaturated : 1
   Detection of functional group : 8
   Confirmation tests (2 Nos) : 8
   Systematic recording : 6

4. Find out physical constant of the given organic compound [2 Marks]
5. Suggest a suitable derivative of the given compound. Prepare and display the derivative of the given compound [3 Marks]

   Derivative preparation procedure: 5
   Display: 5

6. Viva-voce [5 Marks]

MODEL QUESTION PAPER

PROGRAMME: B. SC. CHEMISTRY MODEL I

COURSE CODE: CHE4P02 - ORGANIC CHEMISTRY PRACTICAL-I

Time: 3 hours **Total Marks: 40**

1. Analyze the given organic compound qualitatively. Write down the systematic analysis of the given compound with two identification and confirmation tests

   [30 Marks]
2. Find out physical constant of the given organic compound [2 Marks]

3. Suggest a suitable derivative of the given compound. Prepare and display the derivative of the given compound [3 Marks]
4. Viva-voce [5 Marks]

SEMESTER 5

CHE5COR05 - ENVIRONMENTAL STUDIES AND HUMAN RIGHTS

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

CHE5COR05	ENVIRONMENTAL STUDIES AND HUMAN RIGHTS	L	T	P	C
		3	0	0	3
Objectives	To understand the fragile and sensitive nature of environment, and to realize the importance of its protection,				
Course Outcome(s)					
CO1	To develop an awareness of scope, resources and problems related to environment				
CO2	To understand the legal solutions and awareness of environmental social issues				
CO3	To get an understanding about different types environmental pollutions				
CO4	To understand the basic ideas of toxicology and green chemistry				
CO5	To study nuclear model and nuclear reactions				
CO6	To acquire an awareness of human rights				

Unit 1: Multidisciplinary Nature of Environmental Studies (10 Hrs)

Definition, scope and importance. Need for public awareness. Natural resources: Renewable and non-renewable resources, forest resources - use and over-exploitation, deforestation.

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

Unit 2: Ecosystems (6 Hrs)

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

Unit 3: Social Issues and the Environment (5 Hrs)

Urban problems related to energy. Water conservation, rain water harvesting, water shed management. Resettlement and rehabilitation of people: its problems and concerns.

Environmental ethics: Issues and possible solutions. Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act,Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

Unit 4:. Air, Water and Soil Pollution (8 Hrs)

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

Water pollution**:** Causes- organic, inorganic and macroscopic contaminants, effects of pesticides, insecticides and detergents on water pollution. Marine pollution, eutrophication, biomagnification, water quality parameters-DO, BOD, COD.

Soil pollution: Causes and effects: Agrochemicals, industrial wastes, petroleum wastes, electronic wastes, landfill and dumping. Genetically modified plants.

Unit 5: Toxicology and Toxicological Effects (3 Hrs)

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

Unit 6: Introduction to Green Chemistry (3 Hrs)

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

Unit 7: Environmental Aspects of Nuclear Chemistry (8 Hrs)

Nuclear particles, size of the nucleus - nuclear forces - nuclear stability – N/P ratio – packingfraction – mass defect – binding energy - magic numbers. Nuclear models – shell model andliquid drop model.

Natural radioactivity. Modes of decay- group displacement law — rate of decay – decay constant – half-life period – Gieger-Nuttall rule – disintegration series – transmutation reactions using protons, deutrons, _-particles and neutrons. Artificial radioactivity – positron emission and K electron capture – Transuranic elements, spallation reactions.

Applications of radioactivity: Radio carbon dating – rock dating – isotopes as tracers – study of reaction mechanism (ester hydrolysis). Application of radioactive isotopes in medicine.

Nuclear fission - atom bomb - nuclear reactors – fast breeder reactors. Nuclear fusion and hydrogen bomb. Nuclear waste and its impact on environment – nuclear waste management

Unit 8: Introduction to Human Rights (11 Hrs)

An Introduction to Human Rights, meaning, concept and development. Three generations of human rights (civil and political rights; economic, social and cultural rights).Human Rights and United Nations – contributions, main human rights related organs - UNESCO,UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights. Human Rights in India: Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities. Environment and Human Rights - right to clean environment and public safety.Issues of industrial pollution, prevention, rehabilitation and safety aspect of new technologies such as chemical and nuclear technologies, issues of waste disposal, protection of environment.

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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5COR05 - ENVIRONMENTAL STUDIES AND HUMAN RIGHTS

Module	Hrs Alloted	Part A 2 MarkS 10/12	Part B 5 Marks 6/9	Part C 15 Marks 2/4	Total questions
1	10	2	2	1	5
2	6	1	1		2
3	5	1	1		2
4	8	1		1	2
5	3	1	1		2
6	3	1			1
7	8	2	2		4
8	11	3	2	2	7
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fifth Semester

Core Course: Chemistry

CHE5COR05 - ENVIRONMENTAL STUDIES AND HUMAN RIGHTS

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

PART A (Answer any 10 questions)

1. Define soil erosion.
2. Give two examples for metallic minerals.
3. Give example of a food chain.
4. Discuss any one method for rain water harvesting.
5. What is global warming?
6. What is Minamata disease?
7. Explain the concept of atom economy.
8. What is the significance of N/P ratio?
9. What is Gieger- Nuttall rule?
10. Define human rights. Discuss the various stages of its development.
11. Write a short note on right to information.
12. Evaluate the Marxian approach to the study of human rights.

(10x2=20 Marks)

PART B (Answer any 6 questions)

13. Write notes on renewable and nonrenewable natural resources.
14. Explain the problems associated with over-utilization of surface and ground water.
15. Discuss the structure and function of a forest ecosystem.
16. What do you mean by resettlement and rehabilitation of people? Describe its causes and problems.
17. Discuss the impact of toxic chemicals on enzymes.
18. Discuss the impact of nuclear wastes on environment.
19. Write notes on different nuclear models.
20. Give a brief description on Habeas Corpus.
21. Write notes on fundamental rights.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Discuss the effects of modern agricultural practices and fertilizer pesticide problem on food resources.
23. (a) Discuss briefly the water quality parameters.

    (b) Write a note on (i) eutrophication and (ii) biomagnification.
24. (a) Explain the relationship between science, technology and human rights.

    (b) Write notes on women empowerment. What are the steps takenby the government for the women empowerment?
25. (a) Examine the civil liberties mentioned in the constitution of India.

    (b) Discuss the role of UN in the coordination of human rights.

(2x15=30 Marks)

SEMESTER 5

CHE5COR06- ORGANIC CHEMISTRY-III

(NATURAL PRODUCTS)

Total Hrs: 54; Credits: 3; Hrs/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE5COR06	**ORGANIC CHEMISTRY-III (NATURAL PRODUCTS)**	L	T	P	C
		3	0	0	3
Objectives	To enable the students to gain a detailed knowledge of the chemistry of different natural products and biomolecules.				
Course Outcome(s)					
CO1	To understand the basic structure and properties of carbohydrates.				
CO2	To understand the basic structure and classification of terpenoids, steroids, alkaloids, vitamins and lipids.				
CO3	To understand the basic structure and bonding in amino acids, proteins and green fluorescent proteins.				
CO4	To understand the basic components, biological functions and importance of nucleic acids.				
CO5	To understand the chemical nature, classification and mechanism of action of enzymes.				

Module 1: Natural products - I (Carbohydrates) (18 Hrs)

1.1 Monosaccharides: classification - constitution of glucose and fructose. Reactions of glucose and fructose - osazone formation. Mutarotation and its mechanism. Cyclic structure- Pyranose and furanose forms. Determination of ring size. Haworth projection formula, configuration of monosaccharides, epimerisation, chain lengthening and chain shortening of aldoses. Inter conversion of aldoses and ketoses.

1.2 Disaccharides: Structure of sucrose and maltose. Ring structure. Reactions of sucrose.

1.3 Polysaccharides: Structure and properties of starch and cellulose. (Elementary idea). Industrial applications of cellulose.

Module 2: Natural products –II (Terpenoids, steroids, alkaloids, vitamins and lipids) (18 Hr)

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

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

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

2.4 Vitamins: Classification-structure (elucidation not required) and deficiency diseases of vitamin A, C, B_1, B_2, B_6.

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

Module 3: Natural Products –III (Amino acids, proteins, nucleic acids and enzymes). (18Hrs)

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

3.2 Proteins: Classification of proteins based on physical and chemical properties and on physiological functions. Structure of proteins, helical and sheet structures (elementary treatment only). Denaturation of proteins.

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

3.4 Green Fluorescent Proteins (elementary idea).

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

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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5COR06- ORGANIC CHEMISTRY-III

(NATURAL PRODUCTS)

Module	**Hours Allotted**	**Part A 1 Mark 10/12**	**Part B 5 Marks 6/9**	**Part C 10 Marks 2/4**	**Total questions**
1	18	4	3	1	8
2	18	4	3	1	8
3	18	4	3	1	8
				25. a)- from Module 1 (4 marks) b) from Module 2 (3 marks) c) Module 3 (3 marks)	1
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fifth Semester

Core Course: Chemistry

CHE5COR06- ORGANIC CHEMISTRY-III

(NATURAL PRODUCTS)

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

PART A (Answer any 10 questions)

1. Give two examples of reducing sugars.
2. Which reaction indicates fructose contains five hydroxyl groups?
3. What is celluloid?
4. What are the monomers of maltose?
5. Draw the structure of Vitamin C.
6. What is isoprene rule?
7. Draw the structure of cholesterol.
8. Which are the products obtained when nicotine is oxidized with alkaline $KMnO_4$?
9. Give two examples of acidic amino acids.
10. Draw the zwitter ionic form of alanine.
11. What do you mean by denaturation of proteins?
12. What are the purine bases present in DNA and RNA?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Draw the pyranose and furanose forms of α and β forms of glucose and fructose
14. How will you convert
    a. Fructose to glucose
    b. Glucose to fructose.
15. What is Kiliani synthesis? Give an example.
16. Define saponification value and iodine value of oil? What is their significance?
17. Briefly explain HDL and LDL with their functions.
18. Illustrate the structural elucidation of citral.
19. Write notes on green fluorescent proteins.
20. What are the different types of enzyme inhibition? Explain with examples.
21. Describe solution phase peptide synthesis.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Discuss the industrial applications of cellulose.
23. Discuss the biosynthesis of cholesterol.
24. Discuss the structure of proteins.
25. a). Give the structure and two reactions of sucrose with equations. (4 marks)

    b). Illustrate the synthesis of nicotine. (4 marks)

    c). Explain the Strecker amino acid synthesis. (4 marks)

(2x10=20 Marks)

SEMESTER 5

CHE5COR07 – PHYSICAL CHEMISTRY- I

(STATES OF MATTER AND SURFACE CHEMISTRY)

Total Hours: 36; Credits: 2; Hours/Week: 2; Total Marks 75 (Internal 15 & External 60)

CHE5COR07	PHYSICAL CHEMISTRY- I (STATES OF MATTER AND SURFACE CHEMISTRY)	L	T	P	C
		3	0	0	3
Objectives	To understand the general characteristics of different states of matter				
Course Outcome(s)					
CO1	To understand the nature and properties of fluids				
CO2	To study the intermolecular forces in gases and liquids				
CO3	To understand the dynamics of the molecules in the gases and liquids				
CO4	To study liquefaction of gases				
CO5	To acquire the ability to view 3-dimensional geometry of solids				
CO6	To understand the symmetry of crystals				
CO7	To study defects in crystals				
CO8	To acquire the ability to connect the theories of adsorption with nature.				
CO9	To understand the nanoscience through colloids.				

Module 1: Gases **(12 Hrs)**

Kinetic molecular model of gases: pressure of an ideal gas, derivation of gas laws, Maxwell's distribution of velocities – molecular velocities (average, root mean square and most probable velocities- no derivation). Collision diameter, mean free path, viscosity of gases – temperature and pressure dependence. Relation between mean free path and coefficient of viscosity (no derivation). Barometric distribution law, Law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Real gases: compressibility factor Z, van der Waals equation of state – derivation and application in explaining real gas behaviour. Virial equation of state, van der Waals equation expressed in virial form – calculation of Boyle temperature, Isotherms of real gases, continuity of states. Critical phenomena. Liquefaction of gases (based on Joule-Thomson effect)

Module 2: Liquids **(3Hrs)**

Intermolecular forces in liquids (qualitative idea only)- viscosity, determination of viscosity- the viscometer method – surfacetension – surface energy, refractive index, physical properties and chemical constitution of liquids. Unusual behaviour of water.

Module 3: Solid state **(15 Hrs)**

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

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

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

Module 4: Surface chemistry **(6Hrs)**

Adsorption – types, adsorption of gases by solids – factors influencing adsorption – Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation). The BET theory (no derivation) – use of BET equation for the determination of surface area. Colloids- classification, properties- optical and electrical, coagulation, electrical properties- electrophoresis and electrosmosis. Stability of colloids, origin of charge on colloidal particles, electrical double layer, zeta potential.

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Further reading

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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5COR07 – PHYSICAL CHEMISTRY- I

(STATES OF MATTER AND SURFACE CHEMISTRY)

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	12	3	3	1.5	7.5
2	3	2	1	0	3
3	15	5	4	1.5	10.5
4	6	2	1	1	4
					25

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION
Fifth Semester
Core Course: Chemistry
CHE5COR07 – PHYSICAL CHEMISTRY- I
(STATES OF MATTER AND SURFACE CHEMISTRY)

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

PART A (Answer any 10 questions)

1. The average distance travelled by a molecule between two successive collisions is called ………………..
2. The compressibility factor (Z) for an ideal gas is………
3. Which among the following gases has the highest RMS velocity at a given temperature. Why?
4. H_2 (b) O_2 (c) He (d) Cl_2
5. What is the effect of temperature on the viscosity of a liquid
6. High boiling point of water is due to………………..
7. Mention the crystal system which has maximum number of Bravais lattices. Find the number of atoms present in a unit cell of a monoatomic substance of a face centred cubic crystal system
8. What is the number of tetrahedral voids in a closed packed array of N spheres
9. Define superconductivity and mention the scientist who discovered it?
10. Find out the Miller indices of a plane making the intercepts of 2a, 3b and 2c
11. Give one example each for positively charged colloid and negatively charged colloid
12. State Hardy-Schulze rule. **(10x1=10 Marks)**

PART B (Answer any 6 questions)

13. Calculate the RMS, average and most probable velocity of O_2 gas at 27 °C
14. Explain the role of Joule Thomson effect in the liquefaction of gases using anyone liquefaction process
15. Derive the Bragg equation and state the terms involved
16. Using the van der Waals constants, calculate the critical constants: V_c, P_c and T_c for CO_2 molecule. (a= 3.6 atm L^2 mol^{-2} ; b= 0.0427 L mol^{-1}; R= 0.0821 L atm K^{-1} mol^{-1}).
17. Discuss the conduction mechanism of n-type and p-type semiconductors
18. Explain the various types of three dimensional close packing of spheres
19. Briefly describe the classification of liquid crystals
20. Discuss the electrokinetic phenomena exhibited by colloids
21. Give an account of various types of intermolecular forces.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. (a) Briefly explain the powder method for the X-ray diffraction studies of crystals
    (b) Explain the significance of Maxwell's equation and the effect of temperature on the distribution of molecular velocities
23. (a) Derive Langmuir adsorption isotherm and explain how it is useful in the determination of the surface area of the adsorbent
    (b) Explain the terms electrical double layer and Zeta potential associated with colloids
24. Derive the van der Waals equation of state and illustrate how this equation satisfactorily explains the departure of real gases from Ideal behaviour
25. (a) Discuss the Zinc blende and Wurtzite structures
    (b) Briefly explain intrinsic defects in crystals

(2x10=20 Marks)

SEMESTER 5

CHE5COR08PHYSICAL CHEMISTRY -II

(QUANTUM MECHANICS, SPECTROSCOPY AND PHOTOCHEMISTRY)

Total Hrs: 54; Credits: 3; Hrs/Week: 2; Total Marks 75 (Internal 15 & External 60)

CHE5COR08	PHYSICAL CHEMISTRY -II (QUANTUM MECHANICS, SPECTROSCOPY AND PHOTOCHEMISTRY)	L	T	P	C
		3	0	0	3
Objectives	To understand the fundamentals of quantum mechanics and its applications, molecular spectroscopy and photochemistry.				
Course Outcome(s)					
CO1	To differentiate between classical and quantum mechanics				
CO2	To get aware about the postulates of quantum mechanics and the quantum mechanical model of the hydrogen atom				
CO3	To apply VBT and MOT to explain bonding in molecules.				
CO4	To know the principle and applications of microwave, infrared, Raman, electronic and magnetic resonance spectroscopy.				
CO5	To study the fundamentals of mass spectrometry				
CO6	To apply the fundamentals of photochemistry in daily life situations.				
CO7	To develop numerical ability and problem solving skill.				

Module 1: Quantum mechanics (18Hrs)

Classical mechanics: concepts, failure of classical mechanics, qualitative idea about the energy distribution in black body radiation. Plank's radiation law, Compton Effect.

Binding energy of an electron in hydrogen atom, radius of the hydrogen atom, de Broglie hypothesis, dual nature of electrons – Davisson and Germer's experiment. Heisensberg's uncertainty principle and its significance. Sinusoidal wave equation (no derivation needed). Wave function – physical interpretation, concept of operators, eigen functions, eigen values.

Postulates of quantum mechanics, Particle in one-dimensional box – derivation for energy, application to linear conjugated polyene (butadiene). Introductory treatment of Schrödinger equation for hydrogen atom. Quantum numbers and their importance, hydrogen like wave functions – radial and angular wave functions, radial distribution curves.

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

Module 2: Molecular spectroscopy- I (18Hrs)

Molecular Symmetry - symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, proper and improper axes of symmetry, combination of symmetry elements, molecular point groups, Schoenflies symbol.

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

Rotational spectrum (microwave spectroscopy): diatomic molecules, energy levels of a rigid rotator, selection rules, nature of rotational spectrum, determination of bond length.

Vibrational spectrum (IR spectroscopy): the simple harmonic oscillator – energy levels, force constant, selection rules, nature of vibrational spectrum. Anharmonic oscillator – pure vibrational spectra of diatomic molecules, selection rules, fundamental frequencies, overtones, hot bands. Degrees of freedom for polyatomic molecules, concept of group frequencies – frequencies of common functional groups in organic compounds.

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

Module 3: Molecular spectroscopy - II (15 Hrs)

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

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

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

Module 4: Photochemistry (3 Hrs)

Interaction of radiation with matter: Laws of photochemistry – Grothus-Draper law, Stark-Einstein law, examples of photochemical reactions. Beer law and Beer-Lambert's law. Jablonsky diagram, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Quantum yield, primary and secondary processes. Basic concepts of photosensitized reactions – photosynthesis, dissociation of hydrogen molecule, isomerization of 2-butene, and chemiluminescence.

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3. I.N. Levine, Physical Chemistry, Tata Mc Graw Hill.
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5. K. J. Laidler, John H. Meiser, Physical Chemistry,2ndEdn.
6. C.N. Baanwell and E.M Mc Cash, Fundamentals of molecular spectroscopy 4thEdn., Tata McGraw Hill.
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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5COR08- PHYSICAL CHEMISTRY -II

(QUANTUM MECHANICS, SPECTROSCOPY AND PHOTOCHEMISTRY)

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	3	3	1 + 1/2	7+1/2
2	18	3	3	1 + 1/2	7+1/2
3	15	5	2	1	8
4	3	1	11`	0	2
		12	9	4	**25**

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fifth Semester

Core Course: Chemistry

CHE5COR08- PHYSICAL CHEMISTRY -II

(QUANTUM MECHANICS, SPECTROSCOPY AND PHOTOCHEMISTRY)

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

PART A (Answer any 10 questions)

1. What is meant by a well-behaved wave function?
2. Determine the angular momentum of electron in 4d orbital.
3. Write down Schrodinger wave equation in 3 dimensions.
4. State Beer Lamberts law.
5. Give a molecule belongs to C_{2v} point group.
6. What is Fermi resonance?
7. Draw the proton NMR spectrum of ethanol.
8. What is Larmor precision?
9. State Frank Condon principle.
10. Write the principle behind mass spectroscopy.
11. Differentiate chromophore and auxochrome.
12. Give two examples for photosensitized reactions.

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain Davisson and Germer experiment.
14. Discuss the postulates of Quantum mechanics.
15. Calculate the de- Broglie wavelength of an electron (mass of the electron=9.11 x 10^{-31} Kg) moving at 1% speed of light.
16. Discuss on the no: of vibrational modes and IR peaks of CO_2 molecule. State mutual exclusion principle.
17. Force constant of CO is 1840 cm^{-1}. Calculate the vibrational frequency in cm^{-1}.
18. Derive the expression for bond length of a diatomic molecule using microwave spectroscopy.
19. Explain the terms a) chemical shift b) Sheilding and de shielding effect.
20. Why TMS is reference in NMR spectroscopy. Predict the nmr signals of a) acetaldehyde b) Toluene

21. Explain fluorescence and phosphorescence using Jablonsky diagram.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. a) Compare MOT and VBT

    b) Discuss the physical significance of wave function.

23. a) Derive the expression for energy for a particle in 1 D box.

    b) Discuss briefly the basic principles and quantum theory of Raman effect.

24. a) Explain fundamental band, overtones and hot bands.

    b) The rotational spectrum of $^{79}Br^{19}F$shows a series of successive lines separated by 0.71433cm^{-1}. Calculate B, moment of inertia and inter nuclear distance.

25. a) Explain the principles of mass spectroscopy. How this technique is used in molecular mass determination.

    b) Explain the terms bathochromic shift, hyperchromic shift, hypochromic shift and hypsochromic shift.

(2x10=20 Marks)

SEMESTER 5

CHOICE BASED COURSE–I

(Any one course to be opted from the following courses)

CHE5CBP01:CHEMISTRY IN EVERYDAY LIFE

Total Hours: 72; Credits: 4; Hours/Week: 4; Total Marks 100 (Internal 20 & External 80)

CHE5CBP01	**CHEMISTRY IN EVERYDAY LIFE**	L	T	P	C
		4	0	0	4
Objectives	To learn chemistry as an integral part of everyday life				
Course Outcome(s)					
CO1	To study the general information about the food we eat, the cloths we wear, the drugs we take, the cosmetics we apply and the house hold cleaning materials				
CO2	To learn about the pros and cons of using processed foodstuff,which is in vogue today				
CO3	To become aware of the proper management of the plastics, pesticides, fertilizers and solid wastes				

Module1:Food additives **(18Hrs)**

1.1. Food additives-definition. Preservatives, food colours-permitted and non-permitted, toxicology.Flavours-natural and synthetic. Artificial sweeteners, emulsifying agents, antioxidants, Leavening agents and flavour enhancers.Importance of food additives, toxicology of food additives.Soft drinks-formulation and health effects. Health drinks. Fast foods and junk foods and their health effects.

1.2. Adulteration, Adulterants in milk, ghee, oil, coffee powder, tea, asafoetida, chilli powder, pulses and turmeric powder - identification. Food spoilage: Risk factors associated with food born illness. Spoilage of milk, canned food, fruits and vegetables. Food laws and standards. Food safety and Standards act 2006. Voluntary standards and certification system.

1.3. Measurement of Energy Value of food, Calorific value, calorie requirement, Kilocalorie. Basal metabolic rate (BMR):- Significance, Condition, factors, measurement.

Module2:Household Materials (18Hrs)

2.1 Soaps: Introduction, detergent action of soap, toilet soap, bathing bars, washing soaps, liquid soap manufacture-additives, fillers and flavours.TFM and grades of soap.

2.2 Detergents:- Introduction, detergent action, types of detergents-cationic, anionic, amphiphilic detergents. Common detergent a dditives. Enzymatic detergents. Biodegradable and non-biodegradable detergent. Environmental hazards. Comparison between soaps and detergents.

2.3 Cosmetics:- Introduction, classification–bathing oils, face creams, skin products, perfumes, dental cosmetics, hair dyes, shaving cream, shampoo, talcum powder, toothpaste, deodorants, lipstick–ingredients. General formulation of each type. Harmful chemicals in cosmetics. Toxicology of cosmetics.

Module3: Plastics, Paper and Dyes (9Hrs)

3.1 Plastics in every day life. Brief idea of polymerization– Thermoplastic and thermosetting polymers. Use of PET, HDPE, PVC, LDPE, PP, ABS. Reuse, reduce and recycle of plastics. Biodegradable plastics. Environmental hazards of plastics.

3.2 Newsprint paper, writing paper, paper boards, cardboards. Organic materials, wood, cotton, jute and coir. International recycling codes and symbols for identification.

3.3 Natural and synthetic dyes(basic idea only).

Module4: Drugs (9Hrs)

4.1 Chemotherapy:-Drugs and their classification, Drug-target interactions. Enzymes as drug targets, Receptors as drug targets. Therapeutic action of different classes of drugs-analgesics, antipyretics, antihistamines, antacids, antibiotics, antifertility drugs, psychotropic drugs-tranquilizers, antidepressants and stimulants. Antiseptics and disinfectants.

Module5: Chemistry and Agriculture (12Hrs)

5.1 Fertilizers: natural, synthetic, mixed fertilizers. NPK fertilizers. Excessive use of fertilizers and its impact on the environment. Biofertilizers–types. Nitrogen fixation-symbiotics and nonsymbiotics using mycorrhiza. Plant growth hormones.

5.2 Pesticides:-Classification-insecticides, herbicides, fungicides. Excessive use of pesticides–environmental hazards. Bio pesticides.

Module 6: Integrated Solid Waste Management (6Hrs)

Objectives of solid waste management, types and sources of solid wastes, solid waste disposal methods –incineration, pulverization, pyrolysis, composting-vermi and windrow composting, biogas production. Landfilling- sanitary and secure. Hazardous waste management. Recycling of solid wastes. E-waste management.

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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5CBP01:CHEMISTRY IN EVERYDAY LIFE

Module	Hrs Alloted	Part A 2 Marks 10/12	Part B 5 Marks 6/9	Part C 15 Marks 2/4	Total questions
1	18	1	2	1	4
2	18	2	2		4
3	9	2	2	1	5
4	9	2	1	1	4
5	12	3	2		5
6	6	2	0	1	3
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fifth Semester

Core Course:Chemistry

CHE5CBP01:CHEMISTRY IN EVERYDAY LIFE

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

PART A (Answer any 10 questions)

1. What is a biopesticide? Give examples?
2. Differentiate toilet soap and bathing bars.
3. What do you mean by NPK fertilizer?
4. What is BMR? What is its significance?
5. What is a tranquilizer? Give examples?
6. What is enzymatic detergent?
7. Explain the mode of antibacterial action of penicillin.
8. What are the objectives of solid waste management?
9. What is a dye? How it is classified?
10. What is eutrophication?
11. What is biopol? Give its one application.
12. Recycling is the integral part of solid waste management. Comment.

(10x2=20 Marks)

PART B (Answer any 6 questions)

13. Explain four food safety acts in India
14. Discuss voluntary standards and certification system in India
15. Write a note on recycling codes of Plastics.
16. Explain the benefits of using biofertlizers.
17. Write a note on toxicology of cosmetics.
18. Distinguish between deodorants and antiperspirants.
19. Is emergency contraceptive pill is a medical abortion pill. Why?
20. Explain Drug-target interaction.
21. Write a note on plant growth hormone.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. What are food additives? Explain different types of additives with examples.
23. What is chemotherapy? Explain the classification of chemicals used in chemotherapy according to their mode of action?
24. Discuss various methods of solid waste disposal.
25. Discuss the toxicity and environmental hazards of pesticides

(2x15=30 Marks)

SEMESTER 5

CHE5CBP02: FOOD SCIENCE

Total Hours: 72; Credits: 4; Hours/Week: 4; Total Marks 100 (Internal 20 & External 80)

CHE5CBP02	**FOOD SCIENCE**	L	T	P	C
		4	0	0	4
Objectives	To get a basic understanding of the different aspects of food science				
Course Outcome(s)					
CO1	To understand the chemistry of food adulteration and adulterants				
CO2	To know the methods of analyzing the adulterants				
CO3	To know the chemistry of food poisoning				
CO4	To acquire knowledge about food additives				
CO5	To understand the chemistry of beverages and soft drinks				
CO6	To know the methods of preparing the soft drinks by field visits				
CO7	To acquire knowledge about various edible oils and the processing techniques related to oils				

Module 1: Food Adulteration **(18 Hrs)**

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

Module 2: Food Poisons **(9 Hrs)**

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

Module 3: Food Additives **(18 Hrs)**

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

Module 4: Beverages **(9 Hrs)**

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

Module 5: Edible Oils (18 Hrs)

Fats, oils - Sources of oils - Production of refined vegetable oils - Preservation. Saturated and unsaturated fatty acids – Iodine value - Role of MUFA and PUFA in preventing heart diseases - determination of iodine - value, RM value, saponification value and their significance. Estimation of I_2 and RM values in Edible oils

References

1. Swaminathan M., Food Science and Experimental oods, Ganesh and Company.
2. Jayashree Ghosh, Fundamental concepts of Applied chemistry, S. Chand & Co. Publishers.
3. Thankamma Jacob, Text Books of applied chemistry for Home Science and allied Sciences,Macmillan.
4. B. Sreelakshmi, Food Science, New Age.

SEMESTER 5

CHE5CBP03: FORENSIC SCIENCE

Total Hours: 72; Credits: 4; Hours/Week: 4; Total Marks 100 (Internal 20 & External 80)

CHE5CBP03	**FORENSIC SCIENCE**	L	T	P	C
		4	0	0	4
Objectives	To study some fundamental aspects of forensic science				
Course Outcome(s)					
CO1	To learn Crime investigation through diagnosis of poisoning and postmortem				
CO2	To acquire knowledge about explosions, the causes (gelatin sticks, RDX etc) and the security measures				
CO3	To understand the methods of detecting forgery in bank and educational records				
CO4	To acquire a comprehensive knowledge about tracks and traces				
CO5	To understand the chemical methods used in crime investigation.(Medical aspects)				

Module 1: Poisons **(12 Hrs)**

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

Module 2: Crime Detection **(12 Hrs)**

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

Module 3: Forgery and Counterfeiting **(12 Hrs)**

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

Module 4: Tracks and Traces **(18 Hrs)**

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

Module 5: Medical Aspects **(18 Hrs)**

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

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2. Richard, Criminalistics - An Introduction to Forensic Science (College Version) 8thEdn., Sofestein, Printice Hall.

SEMESTER 5

CHE5CBP04: NANOSCIENCE AND NANOTECHNOLOGY

Total Hours: 72; Credits: 4; Hours/Week: 4; Total Marks 75 (Internal 15 & External 60)

CHE5CBP04	**NANOSCIENCE AND NANOTECHNOLOGY**	L	T	P	C
		4	0	0	4
Objectives	To study the fundamentals of nanoscience and nanotechnology				
Course Outcome(s)					
CO1	To study the basic concepts of nanotechnology and the historical landmarks in this area.				
CO2	To learn the terms and concepts of Nanoscience and different nanosystems like nanoparticles, nanotubes, nanowires and other low-dimensional systems				
CO3	To study the principal properties of nanomaterials and the techniques used to interpret it.				
CO4	To manipulate nanomaterials in areas such as biology, biotechnology medicine, medical diagnosis, sensors etc.				
CO5	To learn the main social, economic and ethical issues related to Nanotechnology				

Module 1: Nanomaterials **(18 Hrs)**

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

Module2: Nanoscience **(18 Hrs)**

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

Module 3: Seeing the nanoworld **(18 Hrs)**

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

Module 4: Applications of nanotechnology **(18 Hrs)**

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

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9. http://www.zyvex.com/nanotech/feynman.html

SEMESTER 5

CHE6D01: CBCSS PROJECT GUIDELINES - BSc CHEMISTRY PROGRAMME

PROJECT

The compulsory project work is a two-credit course that can be carried out individually or as a group of three. However, the viva-voce examination on this will be conducted individually. The project completed as lab work under the guidance of a supervising teacher. It is to be submitted during the practical examination for external valuation.

TOPIC SELECTION

The choice is entirely personal with the help of a teacher from the area of interest or career prospects of students which can be done in the college library.

PROJECT WORK AND EXPERIENTIAL LEARNING

Project work is the best way to practice what you have learned. It provides an opportunity to investigate a problem by applying concepts in a scientific manner. It enables the application of conceptual knowledge in a practical situation and to learn the art of conducting a study in a systematic way and presenting its findings in a coherent report.

A MODEL PROJECT DESIGN

1. Selection of atopic
2. Pilot survey- a trial run
3. Significance
4. Review of literature
5. Coverage (Sample and period of study)
6. Data source
7. Methods of analysis, i.e., tools and techniques
8. Limitation of the study
9. Chapter outline
10. Result chapters
11. Conclusion

STRUCTURE OF THE PROJECT

1. Title page
2. Name of the candidate, name and designation of the supervising teacher
3. Declaration of the student

4. Content
5. Introduction
6. Objective
7. Materials and methods
8. Results and discussion
9. Conclusion
10. References

PROJECT GUIDELINES

Project can be done in about 18 hours and shall be of 10-15 pages in writing. Project reports shall be prepared and submitted to the department at the end of the sixth semester and are to be produced before the practical examiners. The valuation will be done in two stages.

Internal evaluation (the supervising teacher will assess the project and award marks).

External evaluation to be done by the practical examiners.

PROJECT EVALUATION

Components of Project evaluation	**Marks**
Internal Evaluation*	20
Dissertation (end semester)	50
Viva Voce(end Semester)	30

Components of Project Internal evaluation *

Components of internal evaluation	**Marks**
Relevance and Contents	5
Analysis and Presentation	5
Presubmission Presentation and viva	10

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

SEMESTER 6

CHE6COR09 - INORGANIC CHEMISTRY – III

(ADVANCED INORGANIC CHEMISTRY)

Total Hrs: 54; Credits: 3; Hrs/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE6COR09	INORGANIC CHEMISTRY –III (ADVANCED INORGANIC CHEMISTRY)	L	T	P	C
		3	0	0	3
Objectives	To gain detailed knowledge about different analytical techniques and their applications, nanoscience. To introduce the role of metals in biological systems. To get familiarise with organometallic compounds. To provide a basic understanding of different research methodologies in science.				
Course Outcome(s)					
CO1	To understand the separation, purification, thermal and chromatographic techniques				
CO2	To understand the important analytical and instrumental tools used for practicing chemistry				
CO3	To understand the classification, properties and applications of organometallic compounds				
CO4	To study the methods of preparation, properties, structure and bonding of metal carbonyls and metal clusters				
CO5	To understand the role of metals in biological systems.				
CO6	To understand the methods behind research				
CO7	To understand the preparation and applications of nanomaterials				
CO8	To apply these skills in the analysis of experimental data in chemistry practical				

Module I: Analytical Techniques **(9 Hrs)**

1.1. Separation and purification techniques – filtration, crystallization and precipitation – fractional distillation, solvent extraction.

1.2. Gravimetric analysis: Unit operations in gravimetric analysis – illustrations using iron and barium estimation.

1.3. Thermo analytical methods: Principle of thermo gravimetry, differential thermal analysis, differential scanning calorimetry. Applications - TGA of calcium oxalate monohydrate, DTA of calcium acetate monohydrate.

1.4. Chromatography: Column Chromatography - Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications. Thinlayer chromatography-principle choice of adsorbent and solvent Preparation of ChromatoplatesRf-Values, significance of Rf values. Paper Chromatography-Principle, Solvents used, Development of Chromatogram ascending, descending and radial - paper chromatography. Ion - Exchange Chromatography – Principle -Experimental techniques. Gas Chromatography - Principle – Experimental techniques - Instrumentation and applications. High Performance Liquid Chromatography (HPLC) - Principle-Experimental techniques, instrumentation and advantages.

Module 2: Organometallic Compounds (9 Hrs)

Definition, classification of organometallic compounds, classification on the basis of hapticity, naming of organometallic compounds. Catalytic properties of organometallic compounds - alkene hydrogenation, synthesis of water gas – shift reaction, Zeigler-Natta polymerisation, 18 electron rule, metal-alkene complexes, metal-alkyne complexes, carbene and carbyne complexes. Metallocenes – ferrocene (preparation and structure only). Zeise's salt – preparation, properties and structure.

Module 3: Metal carbonyls and metal clusters (9 Hrs)

Preparation and properties of mononuclear carbonyls. Structures of $Mo(CO)_6$, $Fe(CO)_5$ and $Ni(CO)_4$. Polynuclear carbonyls, bridged carbonyls and bonding in carbonyls. Metal clusters - carbonyl and halide clusters, low nuclearity carbonyl clusters and high nuclearity carbonyl clusters, electron counting schemes for $Rh_6(CO)_{16}$ and $[Os_6(CO)_{18}]^{2-}$, metal only clusters (Zintl ions). Metal-halide cluster, Quadruple bond – structure of $[Re_2CI_8]^{2-}$.

Module 4: Bioinorganic Chemistry (9 Hrs)

Essential and trace elements in biological systems, myoglobin and haemoglobin, role of myoglobin and haemoglobin in biological systems, mechanism of oxygen transport, cooperativity, Bohr effect. Vitamin B12 (structure not expected) Metalloenzymes of zinc, inhibition and poisoning of enzymes. Electron carriers – cytochromes. Role of alkali and alkaline earth metals in biological systems, Na/K pump. Biological function and toxicity of metals – Fe, Cu, Zn, Cr, Mn, Ni, Co, Cd, Hg and Pb, treatment of metal toxicity. Anti cancer drugs – Cisplatin and carboplatin

Module 5: Research in Science (4 Hrs)

Selecting a topic – hypothesis-design of experiment: variables, correlation and causality, sampling, use of controls, experimental bias, analysis, results, discussion of results, models. Summary of the scientific methods. Writing Science.

Module 6: Nano materials (9Hrs)

Nano materials – Introduction, General method of synthesis – chemical precipitation, mechano-chemical method, micro emulsion method, reduction technique, chemical vapour deposition and sol-gel method (brief study). Synthesis, Properties and applications of fullerenes and carbon nano tubes.

Module 7: Data Analysis (5Hrs)

Units, significant digits, rounding, scientific and prefix notation, graphing of data -Precision and accuracy – Types of errors – Ways of expressing precision – Ways to reduce systematic errors - reporting analytical data, Statistical treatment of analytical data – population and samples –Mean and standard deviation –distribution of random errors.

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Further Reading

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6. R. Booker and E. Boysen, Nanotechnology, Wiley India Pvt Ltd, 2008.
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SEMESTER VI

PROGRAMME: B.Sc. CHEMISTRY

CHE6COR09 - INORGANIC CHEMISTRY – III

(ADVANCED INORGANIC CHEMISTRY)

Module	**Hrs Alloted**	**Part A 1 Mark 10/12**	**Part B 5 Marks 6/9**	**Part C 10 Marks 2/4**	**Total questions**
1	9	2	1	1	4
2	9	2	3		5
3	9	2	1	1	4
4	9	2	1	1	4
5	4	1	1		2
6	9	1		1	2
7	5	2	2		4
		12	9	4	**25**

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Sixth Semester

Core Course: Chemistry

CHE6COR09 - INORGANIC CHEMISTRY – III

(ADVANCED INORGANIC CHEMISTRY)

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

PART A (Answer any 10 questions)

1. What are essential and trace elements? Give one example for each.
2. What are nanomaterials? Give one example.
3. What is meant by sample and variable?
4. Give one method of preparation for each of $Ni(CO)_4$ and $Fe(CO)_5$.
5. What do you mean by accuracy and precision?
6. What is the biological function of zinc in the body?
7. Draw the structure of $Fe_3(CO)_{12}$
8. What are fluxional molecules? Give one example.
9. What are sandwich compounds? Give one example.
10. Define the term R_f value.
11. Define the term chromatogram.
12. What is the significant digit of 4.1230 and 0.110?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain the method of preparation, properties and structure of Zeise's salt.
14. Explain the details to conduct a research project.
15. What are different types of errors?
16. Classify organometallic compound on the basis of carbon-metal bond.
17. Write a note on Zeigler-Natta Polymerization
18. What is the principle of Thin layer chromatography? What are its applications?
19. What are the ways to reduce systematic errors?
20. What are quadruple bonds? Explain.
21. Give a brief account of Metalloenzymes.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Discuss briefly on Gas chromatographic principle, experimental technique and applications.
23. Give a brief account of Chemical Vapour Deposition and Micro emulsion method. Also describe the properties and applications of Fullerenes and nanotubes.
24. Give a brief account of structure and bonding in metal clusters.
25. What is co-operativity of haemoglobin? Explain the role of haemoglobin and myoglobin in the oxygen transport mechanism in the human body.

(2x10=20 Marks)

SEMESTER 5

CHE6COR10 - ORGANIC CHEMISTRY – IV

(ADVANCED ORGANIC CHEMISTRY)

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

<table>
<tr><td rowspan="2">CHE6COR10</td><td rowspan="2">ORGANIC CHEMISTRY –IV
(ADVANCED ORGANIC CHEMISTRY)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Objectives</td><td colspan="5">To give the students a thorough knowledge about the mechanisms of reactions of some selected functional groups in organic compounds. To provide a basic understanding of different spectral techniques and their applications in simple molecules. To give an outline of applied organic chemistry and the applications of organic chemistry in various spheres of chemical sciences. To familiarize the students with the role and opportunities of chemistry as a discipline in modern civilization.</td></tr>
<tr><td colspan="6">Course Outcome(s)</td></tr>
<tr><td>CO1</td><td colspan="5">To understand the chemistry of nitro compounds, amines, heterocyclics</td></tr>
<tr><td>CO2</td><td colspan="5">To understand the basic spectroscopic techniques</td></tr>
<tr><td>CO3</td><td colspan="5">To elucidate the structure of simple organic compounds using spectral techniques.</td></tr>
<tr><td>CO4</td><td colspan="5">To understand and distinguish various pericyclic and photochemical reactions</td></tr>
<tr><td>CO5</td><td colspan="5">To understand the role of chemistry in human happiness index and life expectancy</td></tr>
</table>

Module I: Organic compounds containing Nitrogen and Heterocyclic compounds (18 Hrs)

1.1. Nitro compounds (3 Hrs): nitromethane- tautomerism- Difference between alkyl nitrites and nitroalkanes. Reduction products of nitrobenzene in acidic, neutral and alkaline media- electrolytic reduction and selective reduction of poly nitro compounds- formation of charge transfer complexes.

1.2. Amines (5 Hrs): Preparation of alkyl and arylamines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds, Gabriel-Phthalimide reaction, Hoffmann bromamide reaction. Isomerism, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines- Structural features affecting basicity of aliphatic and aromatic amines. Quaternary amine salts as phase-transfer catalysts. Comparative study of aliphatic and aromatic amines.

1.3. Diazonium salts: **(3 Hrs)**

Preparation, structure, synthetic applications of benzene diazonium chlorides, azo coupling-. Preparation and uses of Phenyl hydrazine. Diazomethane - preparation, structure and synthetic uses. Arndt Eistert synthesis-mechanism –Wolff rearrangement.

1.4. Heterocyclic compounds **(7 Hrs)**

Structure and aromaticity of five- and six-membered rings containing one heteroatom.Synthesis and reactions of furan and thiophene (any one method), pyrrole (Paal Knorr synthesis), pyridine (Hantzsch synthesis), piperidine (any one method), indole (Fisher indole synthesis), quinoline (Skraup synthesis) and isoquinoline (Bischler – Napieralskii synthesis).Comparative study of the basicity of pyrrole, pyridine and piperidine with amines.

Module 2: Structure elucidation using spectral data (14 Hrs)

2.1. UV Spectroscopy: Types of electronic transitions, λ_{max}, chromophores and auxochromes, bathochromic and hypsochromic shifts. Distinction between cis and trans isomers.

2.2. IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O and N containing functional groups; Effect of H-bonding, conjugation and ring size on IR absorptions. Fingerprint region and its significance. Application in functional group analysis.

2.3. NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift, Spin – Spin coupling and coupling constant, Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.

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

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

Module 3: Pericyclic Reactions and Organic photochemical reactions (6 Hrs)

3.1 Pericyclic reactions: Classification- electrocyclic, cycloaddition (DielsAlderreaction) and sigmatropic reactions. Claisen rearrangement (with mechanism).

3.2. Photochemical reactions: Introduction- Photochemical versus Thermal reactions, Jablonski diagram, Fluorescence and Phosphorescence. Photosensitisation. Norrish reactions of acyclic ketones.Patterno-Buchi reaction, Photo-Fries rearrangement (with mechanism).

Module 4: Applied Organic Chemistry (16 Hrs)

4.1.1. Chemotherapy: **(3 Hrs)**

Drugs: Introduction, Elementary idea of the structure, therapeutic uses and mode of action of the following drugs: Sulphanilamide, Ampicillin, Chloramphenicol, Chloroquine, Paracetamol and Analgin.Drugs in cancer therapy- Chlorambucil. Application of nanomaterials in medicine. (Synthesis of drugs not required)

4.2. Synthetic Polymers: **(5 Hrs)**

Polymers: Classification. Polymerization reactions-Types of polymerization-free radical, cationic and anionic polymerizations (including mechanism). Synthesis and applications of the following polymers- Polyesters- terephthalates, polyamides- Nylon 6 and Nylon 6,6, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes, PVC and Teflon. Plastic identification codes, Biodegradable polymers: PGA, PLA and PHBV. Synthetic rubbers– SBR and Nitrile rubber.

4.3. Supramolecular Chemistry: **(2 Hrs)**

Introduction-Molecular Recognition-Host-guest interactions- types of non-covalent interactions.

4.4. Soaps and Detergents: **(2 Hrs)**

Soaps- Composition.Types of soaps. Cleansing action of soap, TFM. Synthetic detergents- classification. Comparison between soaps and detergents- Environmental aspects.LAS and ABS detergent.

4.5 Dyes: **(4 Hrs)**

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

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SEMESTER VI

PROGRAMME: B.Sc. CHEMISTRY

CHE6COR10 - ORGANIC CHEMISTRY – IV

(ADVANCED ORGANIC CHEMISTRY)

Module	**Hours Allotted**	**Part A 1 Mark 10/12**	**Part B 5 Marks 6/9**	**Part C 10 Marks 2/4**	**Total questions**
1	18	6	3	1	10
2	14	1	3	1	5
3	6	1	0	1	2
4	16	4	3	1	8
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Sixth Semester

Core Course: Chemistry

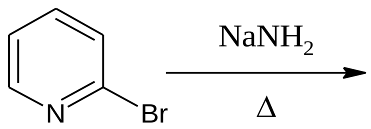
CHE6COR10 - ORGANIC CHEMISTRY – IV

(ADVANCED ORGANIC CHEMISTRY)

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

PART A (Answer any 10 questions)

1. Draw the two tautomeric forms of nitromethane.
2. Which in more basic - aniline or cyclohexyl amine? Explain.
3. Distinguish between alkyl nitrite and nitroalkane.
4. Complete the following reaction.



5. How is diazonium chloride prepared from aniline?
6. What is Hoffmann Bromamide reaction?
7. How many NMR signals would be obtained in the case of $CH_3OCH_2CH_3$?
8. Explain Patterno-Buchi reaction.
9. Name a drug used against Leukaemia.
10. What are the monomers of SBR?
11. What are chromophores? Give an example.
12. Draw the structure of Ampicillin. **(10x1=10 Marks)**

PART B (Answer any 6 questions)

13. How will you separate primary, secondary and tertiary amines? Explain.
14. Explain Arndt-Eistert synthesis with mechanism.
15. Explain the use of quaternary ammonium salts as phase transfer catalysts.
16. An organic liquid containing C, H and O gives an IR absorption at 1720 cm^{-1}. Its ^1H NMR spectrum has a single peak at δ 2.1. Identify the possible structure of the compound and explain your answer.
17. Write a note on anisotropic effects.
18. Explain the fingerprint region in IR spectroscopy.
19. Discuss the various non-covalent interactions in supramolecular chemistry.

20. Draw the structure and explain the mode of action of sulphanilamide.
21. Outline the synthesis of Malachite green.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. (a) What are the products formed when nitrobenzene is reduced under neutral, acidic and alkaline medium?

    (b) Explain Bischler and Napieralskii synthesis.
23. (a) An organic compound having the molecular formula C_4H_8O gives a characteristic band at 275 nm (ε_{max} 17) in its UV spectrum. Its IR spectrum exhibits two important peaks at 2940 – 2855 cm^{-1}. ^1H NMR spectrum of the compound is as follows: δ 2.5 (q, 2H), δ 2.12 (s, 3H), δ 1.07 (t, 3H). Assign a structural formula to the compound.

    (b) How will you determine the molecular mass of a compound by mass spectrometry?
24. (a) What are the various types of polymerization reactions? Explain with the mechanisms.

    (b) Outline the synthesis and uses of Indigo.
25. Illustrate Jablonski diagram to describe the fate of an excited molecule.

(2x10=20 Marks)

SEMESTER 6

CHE6COR11 - PHYSICAL CHEMISTRY – III

(Thermodynamics and Kinetics)

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE6COR11	PHYSICAL CHEMISTRY – III (Thermodynamics and Kinetics)	L	T	P	C
		3	0	0	3
Objectives	To provide an insight into the thermodynamic and kinetic aspects of chemical reactions				
Course Outcome(s)					
CO1	To study the laws of thermodynamics				
CO2	To derive Gibbs-Helmholtz, Clausius-Clapeyron, Gibbs-Duhem equations				
CO3	To derive the relation between K_p, K_c and K_x				
CO4	To derive the phase rule				
CO5	To derive the rate equations for zero, first and second order reactions				
CO6	To study the phase diagrams of one and two component systems				
CO7	To understand the theories of chemical kinetics				
CO8	To get an elementary idea of catalysis including enzyme catalysis				

Module 1: Thermodynamics **(18Hrs)**

Introduction, definition of thermodynamic terms, intensive and extensive properties, path and state functions, exact and inexact differentials, zeroth law of thermodynamics

First law of thermodynamics, reversible and irreversible processes, internal energy and enthalpy, heat capacity, C_p and C_v relation in ideal gas systems, change in thermodynamic properties of an ideal gas during (i) isothermal/adiabatic, reversible/irreversible processes. Joule-Thomson experiment, Joule-Thomson coefficient μ_{JT}, inversion temperature.

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

Second law: Limitations of first law – statements of second law, Carnot's cycle – efficiency of heat engines, Carnot theorem. Entropy – entropy change for various reversible/irreversible processes, spontaneous and non-spontaneous processes. Change in entropy of an ideal gas with pressure, volume and temperature. Third law of thermodynamics-statement and significance

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

Module 2: Chemical Equilibrium and Phase Equillibria (18 Hrs)

Chemical equilibrium: conditions for chemical equilibrium, Le Chatelier's Principle and its applications, relation between K_c, Kp and K_x, van't Hoff reaction isotherm. Temperature dependence of K_p – van't Hoff equation.

The phase equilibria: Phase rule, derivation of the phase rule, equilibrium between phases – conditions. One component system – water system, sulphur system. Two component systems – solid–liquid equilibrium – simple eutectic, thermal analysis, lead–silver system, formation of compounds with congruent melting point- ferric chloride– water system, formation of compounds with incongruent melting point– sodium sulphate–water system. Three component systems having one partially miscible pair – acetic acid-water–chloroform system

Module 3: Kinetics (18Hrs)

Rate of reaction, rate equation, order and molecularity of reactions, integrated rate expressions for first and second order reactions. Zero order reactions, pseudo order reactions, half -life.

Theories of chemical kinetics: effect of temperature on the rate of reaction, Arrhenius equation, concept of activation energy, Collision theory, transition state theory. Thermodynamic parameters for activation – Eyring equation (derivation not required), enthalpy and entropy of activation. Theory of unimolecular reactions – Lindemann theory.

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

Catalysis: Homogeneous catalysis, enzyme catalysis – Michaelis - Menten equation (no derivation needed). Heterogeneous catalysis – surface catalysis, uni and bi molecular reactions on surface. Elementary idea about autocatalysis.

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1. R.P. Rastogi, R.R. Misra, An Introduction to Chemical Thermodynamics, 6thEdn., Vikas Pub. Pvt. Ltd. 2003.
2. P. Atkins and J Paula, The elements of Physical chemistry, W. H. Freeman, 2009
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Further reading

1. J. Rajaram and J. C. Kuriakose, Thermodynamics, Shoban Lal Nagin Chand & Co. New Jersey, 1986.
2. H. Kuhn and H. D. Fosterling, Principles of Physical chemistry, John Wiley & Sons, Chichester, 1999.
3. W.J. Moore, Basic Physical Chemistry, 4thEdn., Orient Longman. New Delhi, 1976.
4. D.A. McQuarrie, J.D. Simon, Physical Chemistry – a molecular approach, Viva Books Pvt.Ltd, 1998.
5. F.A. Alberty and R. J. Silby, Physical Chemistry, John Wiley.
6. G.M. Barrow, Physical Chemistry, 5thEdn., Tata McGraw Hill, New Delhi, 2004.
7. G.K. Vemulapalli, Physical Chemistry, Prentice-Hall of India Pvt. Ltd. 1997.
8. G.W. Castellan, Physical Chemistry, 3rdEdn., Narosa Publishing House, New Delhi, 2004.
9. K.J. Laidler, Chemical kinetics 3rdEdn., Pearson education, 2004.
10. S.H. Marron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Ltd., 1996.

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SEMESTER VI

PROGRAMME: B.Sc. CHEMISTRY

CHE6COR11 - PHYSICAL CHEMISTRY – III

(Thermodynamics and Kinetics)

Module	**HrsAlloted**	**Part A 1 Mark 10/12**	**Part B 5 Marks 6/9**	**Part C 10 Marks 2/4**	**Total questions**
1	18	4	3	1+ ½	8.5
2	18	4	3	1+ ½	8.5
3	18	4	3	1	8
		12	9	4	**25**

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Sixth Semester

Core Course: Chemistry

CHE6COR11 - PHYSICAL CHEMISTRY – III

(Thermodynamics and Kinetics)

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

PART A (Answer any 10 questions)

1. Write the relation connecting entropy, enthalpy and Gibb's free energy
2. Total entropy change in a Carnot's cycle is ----------------
3. Which law is the basis of thermometry?
4. Entropy of a crystal substance at 0K is called ---------------
5. Which order reaction the unit of rate constant is same as the unit of rate of reaction?
6. From the Arrhenius equation draw a plot of against for a reaction
7. Give the rate equation for zero order reaction.
8. Differentiate between homogeneous and heterogeneous catalysis.
9. The equilibrium constant for a reaction is found to be unity at a particular temperature. The standard Gibb's free energy change will be -----------------
10. If for a gaseous reaction at temperature T is unity, Find Kc.
11. The degree of freedom of a mixture composed of liquid O_2, gaseous H_2 and ice is ---------------
12. Name the equation for temperature dependence of equilibrium constant.

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. 1 mol of Argon is expanded reversibly at 800K from 10L to 100L. Calculate the work done in the process.
14. What is the physical significance of entropy? Calculate the entropy change at 298K when 2 moles of an ideal gas expand reversibly from an initial volume of 10 dm3 to a final volume of 20 dm3.
15. Explain carnot heat engine. Calculate the maximum efficiency of a steam engine operating between 127°C and 27°C.
16. What is the difference between order and molecularity of a reaction?
17. Discuss the general characteristics of enzyme catalysis. Explain the mechanism of enzyme action using Michaelis-Menten theory.
18. Half-life of a zeroorder reaction and a first order reaction is 300 seconds. Calculate the half-life when the initial concentration of the reactant is doubled.

19. Write the integrated form of van't Hoff equation and explain the terms involved.
20. Calculate the temperature at which for the reaction .
21. Discuss the phase diagram of lead-silver system with the help of its phase diagram.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. a) Derive van't Hoff equation for the temperature dependence of equilibrium constant. Also derive its integrated form.

    (b)For a homogeneous reaction, the initial concentrations of the reactants are 1M. If the concentration of C is twice the concentration of A, calculate the equilibrium constant

OR

23. (a) Discuss briefly about Joule Thomson effect. Derive a relationship between Joule- Thomson coefficient and heat capacity at constant pressure.

    (b) State and explain phase rule. Draw and discuss the phase diagram for the water system
24. (a) Describe the Lindemann theory of unimolecular reaction.

    (b) Calculate the activation energy and Arrhenius parameter if the reaction follows the equation where and are constants and is the rate constant of the reaction at temperature.

OR

25. (a) State and explain Nernst distribution law. What are its limitations? Give a thermodynamic derivation of this law.

    (b) State and explain third law of thermodynamics. Explain the steps involved in arriving at third law from Nernst heat theorem.

(2x10 = 20 Marks)

SEMESTER 6

CHE6COR12 - PHYSICAL CHEMISTRY – IV

(Solution chemistry and Electro chemistry)

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE6COR12	**PHYSICAL CHEMISTRY – IV (Solution chemistry and Electro chemistry)**	L	T	P	C
		3	0	0	3
Objectives	To provide an insight into the characteristics of different types of solutions and electrochemical phenomena and also to develop problem solving skill in students				
Course Outcome(s)					
CO1	To study the behavior of binary liquid mixtures, CST, azeotropes, colligative properties				
CO2	To study solubility of gases in liquids				
CO3	To study ionic equilibria and electrical properties of ions in solution.				
CO4	To study the concepts of acids and bases, pH and buffer solutions.				

Module 1: Solutions **(18 Hrs)**

Introduction – Binary liquid solutions – Raoult's law – ideal and non-ideal solutions- ΔG_{mix}, ΔV_{mix}, and ΔS_{mix} for ideal solutions. Vapour pressure-composition and boiling point-composition curves of ideal and non-ideal binary liquid solutions. Fractional distillation of binary liquid-liquid solutions – azeotropic mixtures, distillation of immiscible liquids, solubility of partially miscible liquids. Critical solution temperature (UCST, LCST) – the lever rule.

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

Module 2: Ionic Equillibria (3Hrs)

Introduction-concepts of acids and bases, relative strength of acid-base pairs, influence of solvents, Classification of acids and bases as hard and soft acids and bases. Pearson's HSAB concept, applications, Dissociation constants – acids, bases, and polyprotic acids. Ostwald's dilution law.

Module 3: pH and theory of indicators (3Hrs)

Ionic product of water – pH, Buffer solutions – mechanism of buffer action, Henderson equation. Hydrolysis of salts – hydrolysis constant, degree of hydrolysis, pH of salt solutions Acid-base indicators, theories, determination of pH by indicators, solubility product principle – applications.

Module 4: Electrical Conductance (15Hrs)

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

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

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

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

Module 5: Electromotive force (15 Hrs)

Introduction - Galvanic cells, characteristics of reversible cells. Reversible electrodes – different types, electrode potential – electrochemical series. Representation of cells – emf of cell. Thermodynamics of reversible cells and reversible electrodes – Determination of G, H and S of cell reaction. Emf and equilibrium constant of cell reaction, effect of electrolyte concentration on electrode potential and emf (Nernst equation).

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

Applications of emf measurements – determination of solubility product, determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode. Potentiometric titrations, oxidation reduction indicators.

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

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2. K.L. Kapoor, A Textbook of Physical chemistry, Volume 4, Macmillan India Ltd. 2004.
3. I.N. Levine, Physical Chemistry, 6thEdn., Tata Mc Graw Hill, 2011.
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5. K.K. Sharma, L.K. Sharma, A Textbook of Physical Chemistry, 4th Edn,Vikas publishing House, 2009.
6. D.A. McQuarrie, J.D. Simon, Physical Chemistry – a molecular approach, Viva Books Pvt.Ltd, 1998.

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1. H. Kuhn and H. D. Fosterling, Principles of Physical chemistry, John Wiley & Sons, Chichester, 1999.
2. W.J. Moore, Physical Chemistry, 4th Edn., Orient Longman, New Delhi, 1976.
3. F.A. Alberty and R.J .Silby, Physical Chemistry, John Wiley
4. G.M. Barrow, Physical Chemistry, 5thEdn., Tata McGraw Hill, 2006.
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SEMESTER VI
PROGRAMME: B.Sc. CHEMISTRY
CHE6COR12 - PHYSICAL CHEMISTRY – IV
(Solution chemistry and Electro chemistry)

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	7	1	2	10
2	3		1		1
3	3	1	1		2
4	15	2	3	1	6
5	15	2	3	1	6
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Sixth Semester

Core Course: Chemistry

CHE6COR12 - PHYSICAL CHEMISTRY – IV

(Solution chemistry and Electrochemistry)

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

PART A (Answer any 10 questions)

1. Aquatic life is more comfortable at sea level than at higher altitudes, justify.
2. Give the conditions for a solution to behave ideally.
3. Ionic product of water is temperature dependent, justify.
4. Define kohlrauschs law.
5. What are colligative properties?
6. Give the liquid solutions which show both upper and lower CST
7. Write the schematic representation of cell formed by SHE and Copper electrode.
8. Calculate the charge required to deposit one mole of Al^{3+}. ions from $AlCl_3$.
9. What are azeotropes?
10. Draw the vapor pressure-composition curve of binary liquid solutions which show positive deviation.
11. What will be the value of van't Hoff factor for calcium chloride solution which considering complete dissociation?
12. What is the effect of temperature on ionic conductivity?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Give any two methods to determine the PH of solution by EMF measurement.
14. What are fuel cells, Explain?
15. Explain the determination of transport number by moving boundary method.
16. By considering the asymmetry effect and electrophoretic effect explain Deby-Huckel theory of strong electrolyte.
17. What are acid base indicators? Explain the theory.

18. Using pearson HSAB principle how will you classify Hard and Soft acid and bases.
19. Using Nernst equation for electrode potential, Derive Nernst equation for cell potential.
20. Derive Nernst distribution law for particles which undergo association in solution.
21. What is abnormal molecular mass? What is the role of Van't Hoff factor in the case of abnormality?

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Write a note on partially miscible liquid solutions and their CST.
23. a) How will you calculate the molecular mass of non-volatile un-known solute by osmotic pressure method? Why osmotic pressure method is better than other colligative pressure measurement methods.

    b) Write a note on Reverse osmosis and its application.
24. Give the electrochemical theory of corrosion. Different forms of corrosion and methods to prevent corrosion.
25. Briefly explain the applications of any three applications of conductance measurement.

(2x10=20 Marks)

SEMESTER 6

CHOICE BASED COURSE - II

(Any one course to be opted from the following courses)

CHE6CBP01: POLYMER CHEMISTRY

Total Hours: 54; Credits: 3; Hours/Week: 2; Total Marks 100 (Internal 20& External 80)

CHE6CBP01	**POLYMER CHEMISTRY**	L	T	P	C
		3	0	0	3
Objectives	To provide a basic understanding of classification, preparation, physical and chemical characteristics and applications of polymers.				
Course Outcome(s)					
CO1	To familiarize the students with the types of polymers, their significance and to understand the chemistry of formation of polymers				
CO2	To understand the structure – property relationships and method for the separation of polymers and determination of molecular weight and to acquire knowledge about stability and degradation of polymers.				
CO3	To acquire knowledge about the polymerization techniques and polymer processing				
CO4	To know the chemistry of individual polymers, their preparation and properties				
CO5	To have an idea about the recent advances in polymer science				

Module 1: Introduction to Polymers (9 Hrs)

History of polymers: Basic concept- monomers and polymers - definition. Classification of polymers on the basis of origin, microstructures, macrostructures and applications (thermosetting and thermoplastics). configuration and conformation of polymers. Plastics, elastomers and fibers. Homo and heteropolymers. Copolymers. Chemistry of polymerization, Chain polymerization, Free radical, ionic, coordination, step polymerization, Polyaddition and polycondensation, miscellaneous ring-opening & group transfer polymerizations. Zeigler Natta polymerization.

Module 2: Physical Properties and Reactions of Polymers (18Hrs)

Properties: Glass transition temperature (Tg)- measurement of Tg- Factors affecting Tg- relationships between Tg and molecular weight and melting point. Importance of Tg. Molecular weight of polymers and degree of polymerization: Number average, weight average, sedimentation and viscosity average molecular weights. Determination of molecular weight of a polymer. Gel permeation chromatography. Structure-property relationships Reactions: hydrolysis-hydrogenation– addition - substitutions-cross-linking vulcanization and cyclisation reactions. Polymer degradation. Basic idea of thermal, photo and oxidative degradations of polymers.

Module 3: Polymerization Techniques and Processing **(9 Hrs)**

Polymerization techniques: Bulk, solution, suspension, emulsion, melt condensation and interfacial polycondensation polymerizations. Polymer processing: Calendering - die casting, rotational casting - compression. Injection moulding.

Module 4: Chemistry of Commercial Polymers **(9Hrs)**

General methods of preparation, properties and uses of the following Polymers: Teflon, polymethylmethacrylate, polyethylene, polystyrene, PAN, polyesters, polycarbonates, polyamides, (Kevlar), polyurethanes, PVC, epoxy resins, Phenol - formaldehydes and urea-formaldehyde resins.

Natural rubber from latex, isoprene, processing of latex, applications, vulcanization, synthetic rubbers-preparation, properties and applications.

Module 5: Advances in Polymers **(9Hrs)**

Biopolymers - biomaterials. Polymers in medical field. High temperature and fire-resistant polymers. Silicones. Conducting polymers- carbon fibers (basic idea only). Blends and polymer composites.

References:

[1] Billmeyer F.W, Text book of polymer science, Jr. John Wiley and Sons, 1994.

[2] V.R Gowariker, N.V. Viswanathan, and J. Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi, 2006.

[3] B.K. Sharma, Polymer Chemistry, Goel Publishing House, Meerut, 1989.

[4] M.G. Arora., M. Singh. and M.S. Yadav., Polymer Chemistry, 2nd Revised Edn., Anmol Publications Pvt. Ltd., New Delhi, 1989.

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SEMESTER VI

PROGRAMME: B.Sc. CHEMISTRY

CHE6CBP01: POLYMER CHEMISTRY

Module	Hrs Alotted	Part A 2 Marks 10/12	Part B 5 Marks 6/9	Part C 15 Marks 2/4	Total questions
1	9	2	2	1	5
2	18	4	3	1	8
3	9	2	1	1	4
4	9	2	1	1	4
5	9	2	2		4
		12	9	4	**25**

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION

Sixth Semester

Core Course: Chemistry

CHE6CBP01: POLYMER CHEMISTRY

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

PART A (Answer any 10 questions)

1. What are co-polymers? give an example
2. Draw the structure of PVC and poly(isoprene)
3. Calculate the average molecular weight of Polypropylene whose D.P. is 700
4. Antioxidants are often added during processing. Why?
5. Frying pans are coated with Teflon. Give reason.
6. What are plasticizers?
7. What is meant by isotactic polymers? Give an example?
8. What is meant by calendaring?
9. What is vulcanization? give an example
10. What is Zeigler-Natta catalyst?
11. Which are the monomers used for the preparation of polycarbonates?
12. Write any two examples for conducting polymers.

(10x2=20 Marks)

PART B (Answer any 6 questions)

13. Write a short note on classification of polymers.
14. What is oxidative degradation of polymers? Explain the process taking a suitable example.
15. Define glass transition temperature? What is its significance? Explain the factors affecting glass transition temperature
16. Write a short note on silicone polymers.
17. Explain viscosity method of or determination of molecular weight of a polymer
18. Compare suspension and emulsion polymerization.
19. Give a brief account of ring opening polymerization with suitable example.
20. Write a note on conducting polymers and their applications.
21. Discuss the method of preparation and any two uses of the following polymers;
    (a) PTFE (b) PAN

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Write an essay on gel permeation chromatography
23. What is meant by addition polymerization? Briefly explain ionic polymerization.
24. Write a note on synthesis structure, properties and uses of synthetic rubbers
25. Define the term polymerization technique. Give a detailed note on bulk and solution polymerization

(2x15=30 Marks)

SEMESTER 6

CHE6CBP02: NANOCHEMISTRY AND NANOTECHNOLOGY

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

CHE6CBP02	NANOCHEMISTRY AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3
Objectives	To provide a basic understanding of nanochemistry and nanotechnology.				
Course Outcome(s)					
CO1	To study the history, terminology, and scales of nano systems				
CO2	To learn the synthesis and characterization of nano systems				
CO3	To get awareness about electrical and optical properties of nano systems				
CO4	To get a knowledge about the applications of nanomaterials				

Module 1: History (12Hrs)

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

Module 2: Characterization of nanomaterials (15Hrs)

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

Module 3: Electrical and optical properties of nanomaterials (15Hrs)

Electrical and optical properties of nanoparticles- electrical and optical properties of carbon nanotubes- nanocatalysis- nanolithography- nanochemical devices- optoelectronic devices-photodetectors- LEDs and lasers.

Module 4: Applications of nanomaterials (12Hrs)

Nanocrystals- immunogold labeling- applications in medical diagnosis- nanobased drug delivery- applications in biotechnology- nanosensors- self-assembly, nanosensor based on quantum size effects- nanobiosensors- nanomedicines- destructive applications of nanomaterials- nanomaterials in war.

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1. T. Pradeep, Nano: The Essentials, Mc Graw Hill Publishing Company, New Delhi, 2007.
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3. C.N.R. Rao and A. Govindraj, Nanotubes and Nanowires, Royal Society of Chemistry, 2005.
4. J.M.M. Duart, R.J.M. Palma and F.A. Rueda, Nanotechnology and microelectronics and optoelectronics, Elsevier, 2002.
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6. K. J. Klabunde, Nanoscale materials in chemistry, John Wiley and Sons, 2001.
7. C. P. Poole Jr and F J Owens, Introduction to nanotechnology, Wiley India Pvt. Ltd. 2009.
8. http://www.zyvex.com/nanotech/feynman.html.
9. G. L Hornyak, J. Dutta, H.F Tibbals, A.K Rao, Introduction to Nanoscience, CRC Press, 2008.

SEMESTER 6

CHE6CBP03: INDUSTRIAL CHEMISTRY

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks100 (Internal 20& External 80)

CHE6CBP03	INDUSTRIAL CHEMISTRY	L	T	P	C
		3	0	0	3
Objectives	To provide an outline of the application of the principles and techniques of chemistry in the manufacture some industrial products				
Course Outcome(s)					
CO1	To understand the requirements to start an industry - different fuels used and the industrial catalysts used				
CO2	To know about different petrochemical industries				
CO3	To understand the manufacture of fertilizers and speciality chemicals.				
CO4	To acquire knowledge about oils, soaps, detergents, sugar industry, leather and pesticide industries				
CO5	To understand the important process of metallurgy, extraction of metals and environmental problems caused by chemical industries.				

Module 1: Industrial Requirements **(18 hrs)**

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

Module 2: Petrochemical Industries **(18 hrs)**

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

Module 3: Fertilizers and Speciality Chemicals (9 hrs)

Manufacture - Properties and industrial uses of solvents - DMF, DMSO, THF and Dioxane. Fertilizers - Raw materials, manufacture (flow chart chemical process with equations) of ammonium nitrate, ammonium sulphate, urea, calcium cyanamide, calcium ammonium nitrate, sodium nitrate, ammonium chloride, ammonium phosphate, super phosphate of lime, NPK fertilizers. Manufacture in pure form of the following - Sodium carbonate, Oxalic acid, Potassium dichromate, Perchloric acid.

Module 4: Oils, Soaps and Detergents (9 hrs)

Manufacture of Cl_2, NaOH and Chlorates of Na and K - manufacture of perchlorate. Oils - difference between oils and fats - manufacture of cotton seed oil and soybean oil - refining of oil -manufacture of soaps - toilet and transparent soaps - Detergents - synthetic detergents – surface active agents and their classification - manufacture of anionic, cationic and non ionic detergents and shampoo.

Sugar industry - manufacture of sugar from cane sugar and beet root.

Manufacture of leather - hides - Vegetable and chrome tanning finishing.

Manufacture of DDT, dinitrophenols, BHC, gamexane, malathion, parathion.

References:

1. B.K Sharma, Industrial chemistry, Goel publishing House, Meerut, 2003.
2. C.E Drydens, Outlines of Chemical Technology, 3rd Edn., (Edited and Revised by M. Gopal Rao and M. Sittig) Eastwest press, NewDelhi, 1997.
3. R.V Shreve, Chemical Process Industries, 5th Ed., Mc Graw Hill Pub., 1984.
4. H. Steines, Introduction to Petrochemicals, Pergaman Press, 1961.

SEMESTER 6

CHE6CBP04: ENVIRONMENTAL CHEMISTRY

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

CHE6CBP04	ENVIRONMENTAL CHEMISTRY	L	T	P	C
		3	0	0	3
Objectives	To study mainly the chemical aspects of environmental issues				
Course Outcome(s)					
CO1	To study Environmental management and impact assessment				
CO2	To study Toxic effects of pollutants				
CO3	To study Air, water, and soil pollution				

Module 1: Environmental management and impact assessment **(5 Hrs)**

Basic principles, concepts and scope of environmental planning, Conservation of energy – Renewable and non renewable energy sources-nuclear energy, solar energy, hydrogen, non conventional energy sources. Environmental pollution – concepts and definition. Impact assessment- aim, concepts and methods, Environmental management system –ISO-14001.

Module 2: Chemical toxicology **(10 Hrs)**

Toxicity -effects, toxic chemicals in the environment, impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, Co, NOx, SO_2, O_3, PAN, CN, pesticides, carcinogenic substances.

Module 3: Air pollution **(10 Hrs)**

Primary pollutants, hydrocarbons-photochemical smog, particulates, radioactivity, effects of atmospheric pollution - acid rain, ozone layer depletion. Indoor air pollution. Effect of electric and magnetic fields in the environment. Air pollution accidents – Bhopal and Chernobyl.Air quality standards. Sampling and analysis of pollutants – CO, SO_2, H_2S, hydrocarbons, SPM. Noise pollution –measurement, classification, hazards.

Module 4: Water pollution **(17 Hrs)**

Types, effects and sources of water pollution. Pollution of fresh water, ground water and ocean. Thermal pollution. Sampling and measurement of water quality –odour, colour, EC, turbidity, TDS, salinity, COD, BOD, DO, coliform, pH, acidity, CO_2, alkalinity, hardness, NO_3^-, NO_2^-, NH_3, phosphate, fluoride, chloride, cyanide, sulphide, sulphate and metals- As, Cd, Fe, Pb, Hg, SAR,WQI. Water quality parameters and standard. Case study: Kuttanadu wetland. Waste water treatment techniques.

Module 5: Lithosphere **(12 Hrs)**

Composition of soil - reactions in soil. Wastes and pollutants in soil. Sampling procedures and analysis of soil- cation exchange capacity, lime status, lime requirement, gypsum requirement, pH, N, P, K, S, Ca, Mg. Management of solid waste

References

1. A.K. De, Environmental Chemistry, 3rd Edn., New age International Pvt. Ltd. 1996.
2. G.T. Tyler, Living in the Environment, Tomson Brooke/Cole, 2003.
3. N. Manivasakam, Physico-chemical examination of water, sewage and industrial effluents, Pragathi prakashan, 2009.
4. D. Clarson, Soil and water analytical methods, ISBN:81-901483-0-3.
5. R.K. Khitoliya, Environmental Pollution – Management and Control for sustainable development, S. Chand & Company Ltd, 2004.
6. B. B. Kebbekus and S. Mitra, Enveronmental chemical analysis, Blacke Academic & Professional, 1998.
7. S.S. Dara, A Textbook of Environmental chemistry and pollution control, S. Chand & Company Ltd, 2014.
8. R.A. Malaviya, Environmental Pollution and its control under international law, Rawat Publication, 1997.
9. Pramod Singh, Environmental pollution management. Anmol Pub, 1985.
10. G. K. Ghosh, Environmental pollution – A scientific study. APH Publishing Corporation, New Delhi, 1992.
11. Nelson L. Numerow, Industrial water pollution. R.E. Krieger Publishing Company, 1978.
12. James W. Moore and S. Ramamoorthy, Organic chemicals in natural waters, Springer science+ Business media, NewYork, 1984.
13. Hutzinger, Aquatic pollutants, Van Lelyveld and Zoeteman, New York, 1977
14. F. Kreith, Handbook of Solid waste management, Mc Graw Hill Inc, 1994.
15. Peter O' Neil, Environmental Chemistry, Blackie Academic and Professional, London, 2004.
16. S P Mishra and S N Pandey, Essential Environmental Studies, Ane Books Pvt. Ltd, New Delhi, 2011.
17. V K Ahluwalia, Environmental Chemistry, Ane Books Pvt Ltd, New Delhi, 2012.

SEMESTER 6

CHE6CBP05: SOIL AND AGRICULTURAL CHEMISTRY

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

CHE6CBP05	SOIL AND AGRICULTURAL CHEMISTRY	L	T	P	C
		3	0	0	3
Objectives	To study the fundamentals of soil and agricultural chemistry				
Course Outcome(s)					
CO1	To understand the soil and its formation				
CO2	To know the physical properties of soil and other related aspects				
CO3	To acquire knowledge about chemistry aspects of soil and nitrogen fixing process				
CO4	To understand the chemistry of nutrients that are present in soil				
CO5	To understand the chemistry of pesticides, fungicides and herbicides				

Module 1: Origin of Soil **(9 Hrs)**

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

Module 2: Physical Properties of Soil **(9 Hrs)**

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

Module 3: Chemistry Aspects of Soil **(9 Hrs)**

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

Module 4: Plant Nutrients **(18 Hrs)**

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

Module 5: Pesticides, Fungicides and Herbicides **(9 Hrs)**

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

References:

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

SEMESTER 6

CHE6CBP06: PHARMACEUTICAL CHEMISTRY

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

CHE6CBP06	PHARMACEUTICAL CHEMISTRY	L	T	P	C
		3	0	0	3
Objectives	To study the fundamental concepts of pharmaceutical chemistry				
Course Outcome(s)					
CO1	To understand the common diseases and the cure				
CO2	To know the terms of pharmacology				
CO3	To understand the mechanism of drug action				
CO4	To acquire knowledge about chemotherapy and the antibiotics				
CO5	To understand the drugs used for diabetes, hypertension, cholesterolemia				
CO6	To acquire knowledge about various health promoting drugs				

Module 1: Introduction (18 Hrs)

Common diseases - Infective diseases - insect-borne, air-borne and water-borne – hereditary diseases. Terminology - drug, pharmacology, pharmacognosy, pharmacodynamics, pharmacokinetics, anti-metabolites. Absorption of drugs - routes of administration of drugs, factors affecting absorption. Assay of drugs - chemical, biological, immunological assays, LD50 and ED50 therapeutic index, drug dosage.

Module 2: Designation of Drugs (9 Hrs)

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

Module 3: Common Body Ailments (9 Hrs)

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

Module 4: Health Promoting Medicines (18 Hrs)

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

References

1. J. Ghosh, Pharmaceutical chemistry, S. Chand and Company Ltd., New Delhi, 2006.
2. Lakshmi S., Pharmaceutical chemistry, S. Chand & Sons, New Delhi, 1995.
3. Ashutosh Kar, Medicinal chemistry, Wiley Eastern Ltd., New Delhi, 1993.
4. D. William & T. Lemke, Foyes principles of medicinal chemistry, 5th Edn., BI publishers, 2005,
5. Romas Nogrady, Medicinal chemistry, 2ndEdn., Oxford University, 2004.

SEMESTER 5& 6

PRACTICAL: CHE6P03 -QUALITATIVE INORGANIC ANALYSIS

Total Hrs: 54+54= 108; Credits: 3; Hrs/Week: 3; Total Marks 50 (Internal 10 & External 40)

CHE6P03	**QUALITATIVE INORGANIC ANALYSIS**	L	T	P	C
		0	0	3	3
Objectives	To develop skill in qualitative analysis of inorganic compounds				
Course Outcome(s)					
CO1	To enable the students to develop skills in inorganic qualitative analysis.				
CO2	To understand the principles behind inorganic mixture analysis and to apply it in qualitative analysis.				
CO3	To analyse systematically mixtures containing two cations and two anions.				

General Instructions

1. *Semimicro analysis must be adopted for inorganic qualitative analysis.*
2. *Mixtures containing more than one interfering anions must be avoided.*
3. *If interfering anions are not present, cations may be given from the same group.*
4. *Use safety coat, goggles, shoes and gloves in the laboratory.*
5. *A minimum of 8 inorganic mixtures must be done to appear for the examination*

1. Study of the reactions of the following radicals with a view to their identification and confirmation.
   Ag^{+}, Hg^{2+}, Pb^{2+}, Cu^{2+}, Bi^{2+}, Cd^{2+}, As^{3+}, Sn^{2+}, Sb^{3+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, Li^{+}, Na^{+}, K^{+}, NH_4^{+}.
   CO_3^{2-}, S^{2-}, SO_4^{2-} , NO_3^{-}, F^{-}, Cl^{-}, Br^{-}, BO_2^{-}, $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, CH_3COO^{-}, PO_4^{3-} , AsO_3^{3-}, AsO_4^{3-} and CrO_4^{2-}
2. Elimination of interfering anions such as F^{-}, BO_2^{-}, $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, PO_4^{3-}, AsO_3^{3-} AsO_4^{3-} and CrO_4^{2-}
3. Systematic qualitative analysis of mixtures containing two acid and two basic radicals from the above list l by Semi-micro method only. *(Minimum of 10 mixtures to be analyzed)*

References

[1] A.I. Vogel, A Text Book of Qualitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rd Edn., Longmans, Green and Co. Ltd., 1961.

[2] Vogel, A. I., A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis, Longman Green & Co. 1995.

[3] V.V. Ramanujam, Inorganic Semi micro Qualitative Analysis, The National Publishing Co., Chennai.

SCHEME OF VALUATION

SEMESTER 5 &6

PROGRAMME: B.Sc. CHEMISTRY

PRACTICAL: CHE6P03-QUALITATIVE INORGANIC ANALYSIS

Part A	**Systematic qualitative analysis of a given mixture containing two acidic and two basic radicals by semi-micro method**		Marks
(a)	Preliminary analysis of salt mixture (Colour, solubility and Flame tests)		3
(b)	Systematic analysis of 2 acid radicals (anions)		
	1)	Identification tests	4
	2)	Preparation of sodium carbonate extract	1
	3)	Confirmatory tests (2 tests per radical)	4
	4)	Spot tests for anions (1 test per radical)	2
	5)	Correctness in the detection of 2 anions	4
(c)	Systematic analysis of 2 basic radicals (cations)		
	1)	Intergroup Separation	4
	2)	Analysis of Individual groups (Two among Group 0 (ammonium) to Group VI)	4
	3)	Spot tests for cations (1 test per radical)	2
	4)	Correctness in the detection of 2 cations	4
Part B	**Procedure for the elimination of an interfering anion**		2
	(Every student should write a detailed procedure of elimination of an interfering anion as suggested by the examiner)		
Part C	**Viva-voice** (Examiners have discretion to make it as short as they think necessary but maximum duration is 15 minutes. Questions should be strictly based on systematic qualitative analysis)		6
	Total Marks		**40**

MODEL QUESTION PAPER
BSc DEGREE (C.B.C.S.S) EXAMINATION
Fifth and Sixth Semester
Core Course: Chemistry
PRACTICAL: CHE6P03-QUALITATIVE INORGANIC ANALYSIS

Time: 3 Hrs. **Total Marks: 40**

PART A

1. Systematic qualitative analysis of a given mixture containing two acidic and two basic radicals by semi-micro method (32 marks)

PART B

2. Write down (in a separate sheet of answer book) the procedure for the elimination of……………..…………………………….as an interfering anion in the systematic qualitative analysis of salt mixture by semi-micro method

(2 marks)

PART C

3. Viva-voice [you will be invited for an oral examination (maximum 15 minutes duration) by examiners at any time during the course of this examination]

(6marks)

SEMESTER 5& 6

PRACTICAL: CHE6P04 – ORGANIC CHEMISTRY PRACTICAL-II

Total Hrs: 36+36= 72; Credits: 2; Hrs/Week: 2; Total Marks 50 (Internal 10 & External 40)

CHE6P04	**ORGANIC CHEMISTRY PRACTICAL –II**	L	T	P	C
		0	0	2	2
Objectives	To make the students understand how to plan and implement advanced organic reactions				
Course Outcome(s)					
CO1	To practice how to purify and separate organic compounds				
CO2	To study the physical properties of organic compounds				

A. Basic Laboratory Skills

1. Solvent extraction – aniline from water - methyl benzoate from water - using ether- Record the yield recovery- (Any two experiments shall be done).
2. Crystallization – Any four compounds using ethyl acetate, ethanol, and water- Record the yield recovery.
3. Soxhlet extraction

B. Chromatography

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

C. Preparations

Single stage Organic preparations involving. -

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

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

The product to be recrystallized and purity checked by TLC and melting point.

References

1. F.G. Mann and B.C. Saunders, 'Practical Organic Chemistry' 4thEdn., Pearson Education Ltd, 1960.
2. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, Including Qualitative Organic Analysis English Language Book Society Longman, 1978.
3. V.K. Ahluwalia and S.Dhingra, Comprehensive Practical Organic Chemistry, Universities Press, 2004.
4. Gem Mathew, Practical Organic Chemistry.

SCHEME OF VALUATION
SEMESTER 5 &6
PROGRAMME: B.Sc. CHEMISTRY
CHE6P04 – ORGANIC CHEMISTRY PRACTICAL-II

Q. No.	Mark Division	Total
1	Principle :**3** Procedure: **2**	**5**
2	Equation and substitution of values: **2** Result: **2**	**4**
3	Yield: 2 + 2 = **4**, Quality: 2+2 = **4**	**8**
4	Quality: **4** + Rfvalue :**4**	**8**
5	Crude: Quantity: **5** Quality: **5**, Recrystallised: Qnty: **2** + Qual: **3**	**15**

MODEL QUESTION PAPER
BSc DEGREE (C.B.C.S.S) EXAMINATION
SEMESTER 5 &6
PROGRAMME: B.Sc. CHEMISTRY
CHE6P04 – ORGANIC CHEMISTRY PRACTICAL-II

Time: 3hrs **Total Marks: 40**

Note: **Q1.** Ask any one method from Q.No.5

Q2. Dilution of $HCl/H_2SO_4/HNO_3$/HAc/NaOH/Oxalic acid etc.

Use equations $V_1N_1 = V_2N_2$ or $V_1M_1 = V_2M_2$

Q3. Aniline-water/Phenol/water/Ethyl acetate-water/Ethyl benzoate-water etc.

Q4. o-Nitro aniline-p-Nitro aniline/o-Nitro phenol- p-Nitro phenol etc.

Q5.

1. Conversion of Benzyl chloride/ benzyl alcohol/toluene to Benzoic acid by side chain oxidation.
2. Conversion of Benzaldehyde to Benzoic acid by oxidation.
3. Iodoform from acetone.
4. Ethyl/methyl benzoate to Benzoic acid by hydrolysis.
5. Methyl salicylate to salicylic acid by hydrolysis.
6. Nitrobenzene to m-dinitro benzene by nitration.
7. Preparation of Dibenzal acetone from Benzaldehyde

SEMESTERS 5 & 6

PRACTICAL: CHE6P05 – PHYSICAL CHEMISTRY PRACTICALS

Total Hrs: 54+54= 108; Credits: 3; Hrs/Week: 2; Total Marks 50 (Internal 10 & External 40)

CHE6P05	**PHYSICAL CHEMISTRY PRACTICALS**	L	T	P	C
		0	0	3	3
Objectives	The students will learn how to carry out the various physical chemistry experiments and gain skills to explain them.				
Course Outcome(s)					
CO1	To attain lab skills for performing various physicochemical experiments				
CO2	To study how to keep record of instrumental parameters and observations				
CO3	To understand the concepts in theory by performing experiments				

1. Viscosity – percentage composition of a mixture.
2. Heat of solution – KNO_3, NH_4Cl
3. Heat of neutralization strong acid with strong base.
4. Determination of equivalent conductance of an electrolyte
5. Conductometric titration – strong acid *vs.* strong base.
6. Determination of partition coefficient of non-volatile solute between two immiscible solvents. E.g. I_2 between CCl_4 and water.
7. Transition temperature of salt hydrates. (Sodium thiosulphate, sodium acetate)
8. Critical solution temperature. Phenol-water system
9. Determination of molecular weight by Rast's Method (using naphthalene, camphor or biphenyl as solvent and acetanilide, p-dichlorobenzene etc. as solute.)
10. Kinetics of simple reactions eg. Acid hydrolysis of methyl acetate.
11. Potentiometric titration – Fe^{2+} *vs.* $Cr_2O_7^{2-}$, I^- *vs.* MnO_4^-
12. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant)
13. Determination of equivalence point of potentiometric and conductometric titrations using spreadsheet program.

References

1. W.G. Palmer, Experimental physical chemistry, Cambridge University Press, 1941.
2. J.B. Yadav: Advanced Practical Physical Chemistry, 9th Edn., Goel Publishing House, 1989.
3. R.C. Das and B. Behra, Experimental Physical Chemistry, Tata McGraw hill, New Delhi, 1983.
4. K.K. Sharma and DS Sharma, Introduction to Practical Chemistry, Vikas Publishing House, New Delhi, 1989.

SCHEME OF VALUATION

Semester 5 & 6

CHE6 P04: PHYSICAL CHEMISTRY PRACTICALS

1. Write down the procedure/theory of the experiment in the first five minutes.

Expt. No.	Experiment	Procedure	Data	Graph	Calculation	Accuracy	Total
1	CST unknown Composition	5	5	10	-	20	40
2	Rast's Method	5	5	10	5	15	40
3	Conductometry (manual/spread sheet	5	5	10	5	15	40
4	Potentiometry (manual/spread sheet)	5	5	10	5	15	40
5	Vicosity	5	5	10	-	20	40
6	Heat of Neutralization	5	5	5	10	15	40
7	Mass of salt hydrate by transition temperature	5	5	10	5	15	40

% of Error	Marks
Upto 5% error	Full marks
5-6	Deduct 1 mark for every 0.2 %
Above 6%	Deduct 1 mark for every 0.1 %

MODEL QUESTION PAPER

B Sc PROGRAMME IN CHEMISTRY

Fifth & Sixth Semester

CHE6 P04: PHYSICAL CHEMISTRY PRACTICALS

Time: 3 Hrs **Total marks: 40**

1. Study the variation of Miscibility temperature of Phenol Water system on the addition of KCl. Use the data to determine the concentration of the given solution.
2. Find the molecular mass of the given solute by Rast's method. You are provided with a solvent of known mass and kf-------
3. Determine conductometrically the concentration of the given acid. You are provided withstandardNaOH. Find the equivalence point manually or by using spread sheet programme.
4. Determine by Potentiometric titration the concentration of given Fe^{2+}. You are provided with Standard $KMnO_4$. Determine the concentration manually or with the help of spread sheetprogramme.
5. Determine viscometrically the composition of the given sucrose solution.
6. Determine the heat of neutralization of a strong acid by a strong base.
7. Determine the mass of a given salt hydrate from transition temperature. You are provided withKf= ---------------- and molecular mass of solute = --------------.

SEMESTERS 5 & 6

PRACTICAL: CHE6P06 – GRAVIMETRIC ANALYSIS

Total Hrs: 36; Credits: 1; Hrs/Week: 2; Total Marks: 50 (Internal 10 & External 40)

CHE6P06	GRAVIMETRIC ANALYSIS	L	T	P	C
		0	0	2	1
Objectives	To develop skill in quantitative analysis using gravimetric methods.				
Course Outcome(s)					
CO1	To enable the students to develop analytical skills in inorganic quantitative analysis.				
CO2	To understand the principles behind gravimetry and to apply it in quantitative analysis.				

General Instructions

1. For weighing, electronic balance may be used.

2. Use safety coat, goggles, shoes and gloves in the laboratory.

3. A minimum number of 5 experiments must be done, to appearfor the examination.

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

References

1. A.I. Vogel 'A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis': 3rd Edn., ELBS and Longman, London, 1971.
2. J. Bassett, R.C.Denney, G.H. Heffery and J Mendham,. 'Vogel's Textbook of quantitative Inorganic Analysis' John Wiley & Sons, 5th Edn., 1989.

SCHEME OF VALUATION

SEMESTER 5 &6

PROGRAMME: B.Sc. CHEMISTRY

PRACTICAL: CHE6P06 – GRAVIMETRIC ANALYSIS

1. Procedure: **5** marks
2. Calculation: **5** marks

Accuracy: **30** marks

(Up to 1% error, give full marks.
1-2%, deduct 1 mark for every 0.1%
2-3%, deduct 1.5 marks for every 0.1%
Above 3%, give 5 marks as grace mark.)

Give 20, 22, 24 ml solution for estimation.

Estimation	To precipitate as	Wt in 500 ml
Sulphate	$BaSO_4$	19 g K_2SO_4
Barium	$BaSO_4$	28 g $BaCl_2$

MODEL QUESTION PAPER
BSc DEGREE (C.B.C.S.S) EXAMINATION
Fifthand Sixth Semester
Core Course: Chemistry

PRACTICAL: CHE6P06 – GRAVIMETRIC ANALYSIS

1) Write down the procedure and brief theory of the estimation in question no. 2, in the first 10 minutes in a separate sheet of paper. (5 marks)

2) Estimate gravimetrically the mass of ………………….. in the whole of the given solution of …………………………. (35 marks)

SYLLABUS
FOR
COMPLEMENTARY COURSE

CREDIT AND MARK DISTRIBUTION IN EACH SEMESTER

COMPLEMENTARY CHEMISTRY -DETAILED SCHEME

Sl. No	Course Code	Title of the course	Exam. Duration Hours	Credit per Course	Total Contact Hrs for the course	Contact Hrs/ week
First Semester						
1.	CHE1CMP01	Theory: Basic Theoretical and Analytical Chemistry	3	2	36	
	CHE2CP01	Practical: Volumetric Analysis	3	*Evaluation at the end of the 2nd semester*	36	
Second Semester						
2.	CHE2CMP02	Theory: Basic Organic Chemistry	3	2	36	
	CHE2CP01	Practical: Volumetric Analysis	3	2	36	
Third Semester						
3.	CHE3CMP03.1	Theory: Advanced Physical Chemistry - I	3	3	54	
	CHE3CMP03.2	Advanced Inorganic and Organic Chemistry - I	3	3	54	
	CHE4CP02.1	Practical: Physical Chemistry Practical	3	*Evaluation at the end of the 2nd semester*	72	
	CHE4CP02.2	Organic Chemistry Practical	3		72	

Fourth Semester						
4.	CHE4CMP04.1	Theory: Advanced Physical Chemistry - II	3	3	54	
	CHE4CMP04.2	Advanced Bio-organic Chemistry	3	3	54	
	CHE4CP02.1	Practical: Physical Chemistry Practical	3	2	72	
	CHE4CP02.2	Organic Chemistry Practical	3	2	72	

SEMESTER 1

CHEICMP0I- BASIC THEORETICAL AND ANALYTICAL CHEMISTRY

(Common to physical sciences and life sciences)

Total Hrs: 36; Credits: 2; Hrs/Week: 2; Total Marks 75 (Internal 15 & External 60)

CHEICMP0I	**BASIC THEORETICAL AND ANALYTICAL CHEMISTRY**	L	T	P	C
		2	0	0	2
Objectives	To provide an insight to some of the fundamental concepts and principles those are very essential for the study of chemistry. To train the students the laboratory skills that allows developing an interest in judging the accuracy and precision of experimental data. To help the students to develop the skills necessary to solve analytical problems in a quantitative manner.				
Course Outcome(s)					
CO1	To get introduced to the various postulates and theories which led to the development of structure of atom				
CO2	To study the concept of equilibrium and thermodynamics which enables the students to examine the properties of bulk matter				
CO3	To provide a thorough background in chemical principles those are particularly important to analytical Chemistry.				
CO4	To know how the fundamental properties stem from the behaviour of individual atoms and molecules.				
CO5	To introduce a wide range of techniques those are useful in modern analytical Chemistry.				

Module 1: Atomic Structure **(8 Hrs)**

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

Module: Concept of Equilibrium **(5 Hrs)**

Acids and bases – Arrhenius, Lowry - Bronsted and Lewis Concepts, ionic product of water, introductory idea of pH, pOH. Strengths of acids and bases, Ka and Kb, pKa and pKb, buffer solution (elementary idea only), Solvation, solubility, solubility product, common ion effect. Applications.

Module 3: Laws of Thermodynamics (10 Hrs)

System and Surroundings. First law of thermodynamics: Internal energy, Significance of internal energy change, enthalpy, Second law of thermodynamics: Free energy, Entropy and spontaneity, Statement of second law based on entropy, Entropy change in phase transitions (No derivation required)-entropy of fusion, entropy of vaporization, entropy of sublimation.

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

Introduction to metabolism- catabolism, anabolism, Carbohydrate metabolism-introduction, aerobic and anaerobic pathways, glycolysis and its pathways. (Elementary ideas only)

Module 4: Analytical Chemistry - Basic principles (7 Hrs)

Evaluation of analytical data: Accuracy, precision, absolute error, relative error, types of error. Methods of elimination or minimization of errors. Titrimetric method of analysis: General principle, types of titrations, requirements for titrimeric analysis. Concentration terms- molality, molarity, normality, weight percentage, ppm, and millimoles. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions, limitation of volumetric analysis, end point. Acid-base titrations, redox titrations (general idea only). Gravimetric method of analysis: General principle-separation by precipitation. Separation and purification techniques: Recrystallisation, use of drying agents, sublimation. General principles of distillation, fractional distillation, distillation under reduced pressure. Solvent extraction.

Module 5: Chromatographic Techniques (6 Hrs)

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

References:

1. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3 rdEdn., Vishal Pub. CO., 2008.
2. B. R. Puri, L. R. Sharma, K.C.Kalia, Principles of Inorganic Chemistry, 3rdEdn. Milestone Pub. CO., 2009.
3. R. A. Day Junior, A.L. Underwood, Quantitative Analysis, 5thEdn., Prentice Hall of India Pvt. Ltd. New Delhi, 1988.

4. Rastogi, , RD, *Introduction to Chemical Thermodynamics*, 6th Edn, Vikas Publishing House, Pvt. Ltd., 2002.
5. Rajaram and Kuriakkose, *Thermodynamics*, East-West, 1986.
6. Atkins, P.W. *Physical Chemistry*, 8th Edition, Oxford University Press, N Delhi,2006.
7. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, 6^{th}Edn. Pearson Education 2003.
8. J.H. Kennedy, Analytical Chemistry: Principles, Saunders College Pub., 1990.
9. A. K. De, Environmental Chemistry, 3^{rd}Edn., New Age International Pvt. Ltd., 1996.

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SEMESTER 1

Course: Complimentary Chemistry

CHEICMP0I- BASIC THEORETICAL AND ANALYTICAL CHEMISTRY

(Common to physical sciences and life sciences)

Module	**HrsAlloted**	**Part A 1 Mark 10/12**	**Part B 5 Marks 6/9**	**Part C 10 Marks 2/4**	**Total questions**
1	8	3	2	1	6
2	5	2	2	0	4
3	10	3	3	1	7
4	7	2	1	1	4
5	6	2	1	1	4
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

First Semester

Course: Complimentary Chemistry

CHEICMP0I- BASIC THEORETICAL AND ANALYTICAL CHEMISTRY

(Common to physical sciences and life sciences)

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

PART A (Answer any 10 questions)

1. Sketch d_z^2 and d xy orbitals.
2. Write the electronic configuration of Cu (Z=29).
3. State and explain Heisenberg's uncertainity principle.
4. What is Lewis acid? Give two examples.
5. Calculate the pH of 0.1 N NaOH.
6. Write the expression for first law of thermodynamics.
7. Define entropy.
8. Write the relationship between Gibb's free energy and entropy.
9. What is a standard solution?
10. Define accuracy.
11. What is Rf value in chromatography?
12. Write two uses of paper chromatography. **(10x1=10 Marks)**

PART B (Answer any 6 questions)

13. Write a short note on quantum numbers.
14. Difference between an orbit and an orbital.
15. Define buffer solution. Give examples. Write the buffer action of an acidic buffer.
16. Write the applications of common ion effect.
17. What is the third law of thermodynamics? Define entropy.
18. State first law of thermodynamics. A system absorbs 6kJ of heat and performs 3000 J of work. Calculate the internal energy change produced.
19. Write a note on carbohydrate metabolism.
20. What are the requirements for a titrimetric analysis?
21. Write short note on TLC.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. What are the postulates of Bohr's atomic model? What are its merits and demerits?
23. Define Gibbs's free energy and what is its physical significance? What are the conditions for equilibrium & spontaneity based on ΔG values?
24. What are various separation techniques in Analytical Chemistry?
25. Write the principle and applications of

    (a) High performance liquid chromatography

    (b) Ion exchange chromatography.

(2x10=20 Marks)

SEMESTER 2

CHE2CMP02- BASIC ORGANIC CHEMISTRY

(Common to physical sciences & life sciences)

Total Hrs: 36; Credits: 2; Hours/Week: 2; Total Marks 75 (Internal 15 & External 60)

CHEICMP02	BASIC ORGANIC CHEMISTRY	L	T	P	C
		2	0	0	2
Objectives	The course provides fundamental aspects of organic chemistry. For a thorough understanding in Organic Chemistry an undergraduate student is exposed to three fundamental aspects: reactions, mechanism and structure.				
Course Outcome(s)					
CO1	To enable the student to appreciate stereochemistry of organic compounds.				
CO2	To understand mechanisms of some basic organic reactions through the concept of hybridization.				
CO3	To know the classification of polymers, polymerization reactions, and the structure and uses of some commercial and natural polymers.				

Module 1: Stereochemistry of Organic Compounds (13Hrs)

Geometrical isomerism- cis and trans configuration, determination of configuration and interconversion of cis-trans isomers, E and Z configuration. Optical isomerism- Optical activity, Chirality, Stereogenic Centre, Enantiomers and diastereomers, Racemisation, Resolution.Conformation- Newman projection, Saw-horse projection. Conformations of Ethane, n-Butane and Cyclohexane.

Module 2. Mechanisms of Organic Reactions (15 Hrs)

Hybridization- sp^3, sp^2 and sp, (ethane, ethene, ethyne). Polarity of bonds. Inductive, mesomeric, and hyperconjugative effects. Bond fission- homolytic and heterolytic fission. Reaction intermediates- radicals, carbocations and carbanions.

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

Substitution reactions: nucleophilic substitution of alkyl halides- S_N1 and S_N2 mechanisms. Electrophilic substitution in benzene-reaction mechanism.

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

Elimination reactions: E_1 and E_2mechanisms.

Module 3. Natural and Synthetic Polymers (8 Hrs)

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

References

1. I.L. Finar, Organic Chemistry - Volume I, Pearson Education, 1973.
2. S. M. Mukherji, S. P Singh, R. P Kapoor, Organic Chemistry Vol.1, New Age International (P) Ltd, 2006.
3. Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, 6thEdn., Orient Longman, 1988.
4. S. M. Mukherji, S.P Singh, Reaction Mechanism in Organic Chemistry, Macmillan, 3rdEdn., 2003.
5. V. R. Gowariker, Polymer Chemistry, New Age International Pvt. Ltd., New Delhi, 2010.
6. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1st Multi colour Edition, S. Chand & Company, New Delhi, 2010.
7. K.S. Tiwari, N.K. Vishnoi, A Text Book of Organic Chemistry, Vikas Publishing House, 2006.

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SEMESTER 2

Course: Complimentary Chemistry

CHE2CMP02- BASIC ORGANIC CHEMISTRY

(Common to physical sciences & life sciences)

Module	Hours Allotted	Part A	Part B	Part C	Total questions
		1 Mark	5 Marks	10 Marks	
1	13	4	4	1	9
2	15	5	3	2	10
3	8	3	2	1	6
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Second Semester

Course: Complimentary Chemistry

CHE2CMP02- BASIC ORGANIC CHEMISTRY

(Common to physical sciences & life sciences)

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

PART A (Answer any 10 questions)

1. Draw the structural formula of cis and trans isomers of but-2-ene
2. What is plain polarized light?
3. Draw the structure of meso tartaric acid.
4. What are enantiomers?
5. What are the mononers of Nylon 6, 6?
6. Write one example each for natural and synthetic polymers.
7. Write the IUPAC name of monomer of natural rubber.
8. Write any two electron displacement effects found in organic compunds.
9. Which is the major product obtained by the addition of HBr to propene?
10. What do you understand by the term SN^1reaction?
11. Why aniline is less basic than ammonia?
12. Hyper conjugation is also known as no-bond resonance. Why?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. How will you distinguish between maleic and fumaric acid by chemical reaction? Write the chemical reactions to substantiate your answer.
14. Distinguish between conformation and configuration with suitable examples.
15. What is the difference between enantiomers and diastereomers? Explain using optical isomers of tartaric acid
16. Describe the geometrical isomerism shown by aldoximes and ketoximes.
17. Distinguish between thermoplastics and thermosetting plastics with suitable examles. How do elastomers differ from plastics?
18. Write a note on the environment hazards of polymers.
19. Write the mechanism of sulphonation of benzene.
20. Explain the terms E1 and E2 in connection with dehydrohalogenation with suitable examples.

21. What is mesomeric effect? Explain with suitable examples.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. How polymers are classified based on different criteria?
23. Describe (a) E and Z nomenclature of Geometrical isomers
    and (b) D and L configurations of optical isomers
24. Explain (a) Inductive effect
    (b) Electromeric effect
    (c) Steric effect
    and (d) Peroxide effect
25. Write The mechanisms of (a) Halogenation
    (b) Nitration
    (c) Friedel – Crafts reaction of benzene

(2x10=20 Marks)

SEMESTERS 1 & 2

CHE2CP01: VOLUMETRIC ANALYSIS PRACTICAL - I

(Common to physical sciences & life sciences)

Total Hrs: 36+36= 72; Credits: 2; Hrs/Week: 2; Total Marks 50 (Internal 10& External 40)

CHE2P01	**VOLUMETRIC ANALYSIS**	L	T	P	C
		0	0	2	2
Objectives	Experimental practice of quantitative volumetric analysis. To determine the amount of a substance in a given sample. To get familiarize with the concept of concentration of solutions				
Course Outcome(s)					
CO1	To develop skills for quantitative estimation using the different branches of volumetric analysis.				
CO2	To facilitate the students to make solutions of various molar concentrations.				

General Instructions

1. Use safety coat, goggles, shoes and gloves in the laboratory.
2. For weighing electronic balance may be used.
3. Standard solution must be prepared by the student.
4. Double titration method may be used for volumetric titrations
5. Experiments may be selected in such a way that preference may be given for Modules I and II.
6. A minimum number of, two experiments from module III.
7. A total of 12 experiments must be done from Modules I to V to appear for the examination.
8. Practical examination will be conducted at the end of semester II.

I. Acidimetry and Alkalimetry

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

II. Permanganometry

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

III. Dichrometry

1. Estimation of Ferrous ion (external indicator).

2. Estimation of Ferrous ion (internal indicator).

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

IV. Iodimetry and Iodometry

1. Standardization of Iodine solution.

2. Standardization of Sodium thiosulphate.

3. Estimation of $KMnO_4$.

4. Estimation of Copper.

V. Gravimetric Analysis

1. Determination of percentage of water in Barium chloride crystals.

2. Estimation of Barium as Barium sulphate.

References

1. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry, 8thEdn, Brooks/Cole Nelson, 2006.
2. A.I. Vogel, G.H. Jeffery, Vogel's Textbook of Quantitative Chemical Analysis, 6thEdn.,Longman Scientific & Technical, 1989.
3. G. D. Christian, Analytical Chemistry, 6thEdn, John Wiley and Sons, 2004.
4. R.D Day, A.L. Uderwood, Quantitative analysis, 6thEdn., Prentice Hall of India Pvt. Ltd., 1991.

SCHEME OF VALUATION
CHE2CP01: VOLUMETRIC ANALYSIS PRACTICAL

(Common to physical sciences & life sciences)

No.	Mark Division	Total marks
1	Presenting data- 4 Calculation- 4 Accuracy upto 1.5%- 22 Marks (1.6-2: Deduct 1 mark for each 0.1 % 2.1-2.5: Deduct 2 mark for each 0.1 % Above 2.5%: 5 marks)	**30**
2	Principle-1 Procedure-3	**4**
3	Molecular mass and Equation- 1 Substitution and Result-1	**2**
4	Viva Voce	**4**

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION

Semester 1 & 2

Course: Complimentary Chemistry

CHE2CP01: VOLUMETRIC ANALYSIS PRACTICAL

(Common to physical sciences & life sciences)

Time: 3 Hrs **Total Marks: 40**

1. Estimate volumetrically the mass of ……………. in the whole of the given solution. You are supplied with an approximately ……………. solution of …………… and pure ……….. crystals. **(30 Marks)**
2. Write the principle and procedure for the estimation as required in Q.1 **(4 Marks)**
3. Calculate the mass of ………….. you have to weigh out accurately to prepare ………….. ml of ….. solution for Q.1 **(2 Marks)**
4. Viva – Voce **(4 Marks)**

(Submit answer 2 and 3 within 10 minutes.)

SEMESTER 3

CHE3CMP03.1 - ADVANCED PHYSICAL CHEMISTRY – I

(For students who have opted Physical Sciences as Main)

Total Hrs: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE3CMP03.1	**ADVANCED PHYSICAL CHEMISTRY – I**	L	T	P	C
		3	0	0	3
Objectives	This course makes the concepts and methods of physical chemistry clear and interesting to students, who have basic ideas in mathematics and physics. The course covers basic ideas of nuclear chemistry, surface chemistry, phase equillibria and give an insight to different states of matters.				
Course Outcome(s)					
CO1	To understand nuclear reactions and their applications along with disposal of nuclear wastes				
CO2	To get a brief idea about the different symmetry elements and symmetry operations				
CO3	To enable the students about the classification, properties and theories of solid state and liquid state				
CO4	To give an insight to the chemistry of the surface, colloidal properties and different phase systems				

Module 1: Nuclear Chemistry (13 Hrs)

Stability of Nucleus: - binding energy, magic number, packing fraction, n/p ratio. Radioactivity: detection, GM counter, units of radioactivity. Nuclear Processes: natural radioactivity, induced radioactivity, fertile and fissile isotopes. Half life period, disintegration constant, Nuclear Reactions: fission and fusion, chain reactions, disposal of nuclear wastes.

Reactors – conventional and breeder, energy generation, rock dating and radiocarbon dating, neutron activation analysis; medical, agricultural and industrial applications.

Module 2: Symmetry and Molecular Structure (6 Hrs)

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

Module 3: Solid State **(15 Hrs)**

Classification: amorphous, crystalline – differences. Lattice, lattice energy (general idea), unit cell, examples of simple cubic, bcc and fcc lattices, calculation of number of molecules in a unit cell, calculation of lattice parameters of cubic unit cell. Weiss and Miller indices, crystal systems, Bravais lattices, X-ray diffraction – Bragg's equation, structure determination of NaCl by X-ray diffraction. Theories of Solids: metallic bond, band theory, conductors, semiconductors and insulators, mention of super conductors. Magnetic Properties: classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferrimagnetic, permanent and temporary magnets.

Module 4: Liquid State **(6 Hrs)**

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

Module 5: Surface Chemistry and Colloids **(6 Hrs)**

Adsorption – types of adsorption of gases by solids, factors influencing adsorption, Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation not required). Colloids: preparation, properties – optical and electrical, electric double layer, coagulation, electrophoresis, electroosmosis, surfactants, micelle, applications of colloids.

Module 6: Phase Equilibria **(8 Hrs)**

Phase, component, degree of freedom. Phase rule (No derivation) One component system – water system. Two component system= general discussion of simple eutectic – lead-silver system. Pattinson's process.Liquid-liquid-equilibrium – partially miscible and immiscible liquid systems – CST –upper CST and lower CST.

References:

[1] H.J. Arnikar ,Essentials of Nuclear Chemistry, 4thEdn., New Age International Pub., 1995.
[2] B.R. Puri, L.R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 40 thEdn., Vishal Pub. Co., Jalandhar, 2003.
[3] P. Atkins and J Paula, The elements of Physical chemistry, Oxford University Press, 2009.
[4] A.R. West, Solid State Chemistry and its applications, John Wiley, 2014.
[5] L.V.Azaroff, Introduction to Solids, McGraw Hill, 1984.

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SEMESTER III

Course: Complimentary Chemistry

CHE3CMP03.1 - ADVANCED PHYSICAL CHEMISTRY – I

(For students who have opted Physical Sciences as Main)

Module	HrsAllote d	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	13	4	2	1	7
2	6	1	1		2
3	15	2	3	1	6
4	6	2	1	1/2	3.5
5	6	2	1	1/2	3.5
6	8	1	1	1	3
		12	9	4	**25**

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION

Third Semester

Course: Complimentary Chemistry

CHE3CMP03.1 - ADVANCED PHYSICAL CHEMISTRY – I
(For students who have opted Physical Sciences as Main)

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

PART A (Answer any 10 questions)

1. Write the relationship for half-life and decay constant for radioactive disintegration.
2. Give the SI unit for radioactivity
3. Name the electromagnetic radiation in radioactivity.
4. What is group displacement law?
5. In………. point group, the elements are identity, proper rotational elements and two vertical plane reflections.
6. Find number of atoms per unit cell in body-centered cubic lattice.
7. In NaCl crystal, sodium ions and chloride ions form the ……. lattice.
8. Define viscosity. How does viscosity vary with temperature?
9. Differentiate between Absorption and AdsorptionHgh
10. Give an example for a solid in liquid colloid.
11. Write different types of liquid crystals.
12. What is the degree of freedom for triple point of water?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. The half-life of a radioactive element is found to be 30days. Find its decay constant and the time required for the substance to reduce to $1/4^{th}$ of the original amount.
14. Discuss the principle and working of nuclear reactors.
15. Which are the elements combined in $C3_v$ point group?
16. Give a sketch of all the three cubic space lattices
17. Calculate the Miller indices of crystal planes which cut through the crystal axes at i) (2a, 3b, c) ii) (2a, -3b, -3c). Also find the inter planar spacing
18. Why do X-ray wavelets get diffracted while encountering lattice particles in crystals? Give Bragg equation.
19. What are liquid crystals? Describe the characteristics and properties of liquid crystals.

20. Draw the phase diagram of lead-silver system and discuss.
21. Discuss any three methods for the preparation of colloids.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Write briefly on

    (a) Disposal of nuclear wastes and related problems.

    (b)Neutron activation analysis and applications of radioisotopes
23. Derive the Bragg's equation and show how the expression is made use in Bragg X-ray single crystal diffraction and Powder methods of crystal study.

    b) Discuss the structure of NaCl
24. a) Explain thermographic behavior of liquids.

    b) Discuss the phase diagram of water system.
25. a) Write Freundlich Adsorption equation and discuss the significance of various terms involved.

    b) What is meant by CST. Explain upper CST and lower CST.

(2x10=20 Marks)

SEMESTER 3

CHE3CMP03.2- ADVANCED INORGANIC AND ORGANIC CHEMISTRY

(For students who have opted Biological Sciences)

Total Hrs: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE3CMP03.2	**ADVANCED INORGANIC AND ORGANIC CHEMISTRY**	L	T	P	C
		3	0	0	3
Objectives	The course promotes understanding of facts and concepts in inorganic and organic chemistry. The course includes six modules which cover basic ideas which enables the students a basic understanding of nuclear chemistry and heterocyclic compounds and help to learn about various types of food additives, chemotherapy and the role of chemistry in agriculture.				
Course Outcome(s)					
CO1	To understand the importance of nuclear reactions and their applications in different fields				
CO2	To get a brief idea about the chemistry behind pesticides, insecticides, herbicides, fungicides etc.				
CO3	To give an insight to the chemistry of living systems				
CO4	To discuss the aromatic properties of heterocyclic compounds				
CO5	To understand the basic ideas behind the action of drugs on human body and different types of food additives we use in daily life				

Module 1: Nuclear Chemistry (10 Hrs)

Radioactivity- natural radioactivity, artificial radioactivity, disintegration rates, half-life period and disintegration constant.

Nuclear Reactions - nuclear fission and nuclear fusion, nuclear reactors.

Applications of radioisotopes - carbon dating, rock dating, in medicine, in agriculture, and in industry.

Module 2: Chemistry and Agriculture (12 Hrs)

NPK representation, superphosphates, triple super phosphate, uses of mixed fertilizers, micronutrients and their role, bio-fertilizers, plant growth hormones.

Pesticides-classifications with simple examples, mention of biopesticides.

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

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

Fungicides- inorganic and organic- Bordeaux mixture, diothiocarbamates.

Excessive use of pesticides – environmental hazards.

Module 3: Chemistry of Living cell (9 Hrs)

Thermodynamics of Living cell- Exergonic and endergonic reactions, coupled reactions, biological oxidation reactions (general idea)

Photosynthesis- Metalloporphyrin, chlorophyll, elementary idea of photophosphorylation. Photosynthesis and respiration – comparison.

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

Module 4: Aromaticity and Heterocyclic Compounds (12 Hrs)

Aromaticity – Huckel rule, theories of aromaticity, structure and aromaticity of furan, pyrrole, pyridine, indole, pyrimidine and purine.

Heterocyclic compounds- classification, methods of preparation (any one method) of furan, pyrrole, pyridine, indole, pyrimidine and purine.

Module 5: Chemotherapy (6 Hrs)

Outline study, mode of action and applications of antibiotics, sulpha drugs, antipyretics, analgesics, tranquillizers, and antidepressants (preparation and structures not needed). Drug addiction, abuse and prevention

Module 6: Food Additives (5 Hrs)

Artificial sweeteners – saccharin, cyclamate aspartame (general idea).

Food flavours (names only) –esters, aldehydes and heterocyclic compounds.

Food colours- restricted use, spurious colours.

General discussion of emulsifying agents, preservatives, leavening agents, baking powder, yeast.

Taste-enhancers- MSG, vinegar (structures not needed).

References

1. I.L. Finar, Organic Chemistry - Volume I, Pearson Education, 1973.
2. I .L. Finar, Organic Chemistry – Volume II, Pearson Education, 1956.
3. H. J. Arnikar,Essentials of nuclear chemistry, Revised 4thEdn., New Age International Publications, 1995.
4. G. T. Austin, Shreve's Chemical process Industries, 5thEdn.,McGraw Hill, 1984.
5. Rastogi, Biochemistry, Tata McGraw. Hill Publication, 1996.
6. B. Sreelakshmi, Food Science, New Age International Pvt Ltd, New Delhi, 2010.
7. C. N. Pillai, Organic Chemistry for under graduates, Universities Press, 2008.
8. A. Kar, Medicinal Chemistry, New Age International, 2007.

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SEMESTER 3

Course: Complimentary Chemistry

CHE3CMP03.2- ADVANCED INORGANIC AND ORGANIC CHEMISTRY

(For students who have opted Biological Sciences)

Module	**HrsAllote d**	**Part A 1 Mark 10/12**	**Part B 5 Marks 6/9**	**Part C 10 Marks 2/4**	**Total questions**
1	10	3/12	1/9	1/4	5
2	12	2/12	2/9	1/4	5
3	9	1/12	1/9	1/4	3
4	12	1/12	2/9	1/4	4
5	6	1/12	2/9	0/4	3
6	5	4/12	1/9	0/4	5
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Third Semester

Course: Complimentary Chemistry

CHE3CMP03.2- ADVANCED INORGANIC AND ORGANIC CHEMISTRY

(For students who have opted Biological Sciences)

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

PART A (Answer any 10 questions)

1. Write the use of moderator in nuclear reaction? Give an example.
2. Name the radioactive isotope used to detect blood clots and blocks in veins.
3. Which nuclear reaction is called thermonuclear reaction? Why ?
4. What does NPK value indicate?
5. What are mixed fertilizers?
6. Define photophosphorylation.
7. State Huckel's rule of aromaticity.
8. Give any two examples of tranquilizers.
9. Give an example for a food colorant.
10. What is MSG?
11. What is the drawback of aspartame?
12. For what purpose leavening agents are used? **(10x1=10 Marks)**

PART B (Answer any 6 questions)

13. Explain the working of a nuclear reactor with a simple diagram.
14. What are fungicides? Explain different types of fungicides with examples?
15. Write any one method for the preparation of a) DDT and b) BHC.
16. Write a short note on biological oxidation reactions.
17. Discuss the classification of heterocyclic compounds. Depict the structure of Furan and Indole.
18. Explain Huckel rule of aromaticity. Comment the aromaticity of pyridine.
19. Write a short note on Sulpha Drugs.
20. Describe antipyretics and analgesics.
21. Explain the various preservatives and artificial sweeteners used in food.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Explain the application of radioisotopes in carbon dating and agriculture
23. Discuss the impact of excessive use of fertilizers and pesticides on environment.
24. Explain the chemistry behind oxygen transport through haemoglobin
25. a) What is meant by aromaticity? Comment on the aromaticity of furan.

    b) Give one method each for the preparation of a) Pyridine b) Pyrimidine and c) Purine

(2x10=20 Marks)

SEMESTER 4

CHE4CMP04.1: ADVANCED PHYSICAL CHEMISTRY – II

(For students who have opted Physical Sciences as Main)

Total Hrs: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE4CMP04.1	**ADVANCED PHYSICAL CHEMISTRY – II**	L	T	P	C
		3	0	0	3
Objectives	The course help the students to get a basic idea about spectroscopy and photochemistry, enable the students to study the rules governing chemical reactions and factors influencing them and to study basics of electrochemistry, electro motive force and chemical kinetics.				
Course Outcome(s)					
CO1	To understand the basic concepts of spectroscopy, photochemistry and redox reactions				
CO2	To study the rules governing chemical reactions and apply it in advanced level				
CO3	To acquire knowledge about different cells and their reactions				
CO4	To study basic concepts of electrochemistry and their applications				

Module1: Introduction to Spectroscopy (12 Hrs)

Interaction of electromagnetic radiation with matter, electromagnetic spectrum, quantization of energy, electronic, vibrational and rotational energy levels, Boltzmann distribution of energy (formula only), population of levels. UV- Visible Spectroscopy: Beer Lambert's law, molar extinction coefficient and its importance, UV spectrum, $\square_{max}$, chromophore, auxochrome, red shift,blue shift, types of transition. Infra-red spectroscopy: vibrational degrees of freedom, types of vibrations – symmetric and asymmetric stretching and bending. Concept of group frequencies-frequencies of common functional groups in organic compounds. Rotational Spectroscopy: diatomic molecules, determination of bond length.

Module 2: Chemical Kinetics (8 Hrs)

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

Module 3: Photochemistry (5 Hrs)

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

Module 4: Electrochemistry (12 Hrs)

Conductance of electrolytic solution, electrolytic conductivity (K), and molar conductivity (Λ) of solutions of electrolytes. Variation of conductivity and molar conductivity with concentration. Kohlrausch's law – application. Faraday's laws of electrolysis, electrochemical equivalent and chemical equivalent, transport number determination by Hittorf's method. Applications of conductance measurements – K_w, K_{sp}, conductometric titrations, strong and weak electrolytes. Ostwald's dilution law, hydrolysis of salts.

Module 5: Electromotive Force (11 Hrs)

Galvanic cells, characteristics of reversible cells. Reversible electrodes – different types, electrode potential – effect of electrolyte concentration on electrode potential and emf (Nernst equation). Electrochemical series, representation of cell, EMF of cell. EMF and equilibrium constant of cell reaction, concentration cells – general discussion of electrode – concentration cell and electrolyte concentration cells. Liquid junction potential, fuel cells – the hydrogen – oxygen fuel cell.

Application of EMF measurement – determination of pH using hydrogen electrode, quinhydrone electrode, glass electrode- potentiometric titrations.

Module 6: Redox reactions (6Hrs)

Oxidation-reduction reactions: explanation with examples, oxidation states, rules to assign oxidation states in polyatomic molecules, determination of oxidation states. Oxidation reduction titrations, experimental method, example.

References:

[1] C. N. Banwell, E.M. Mc Cash, Fundamentals of Molecular Spectroscopy, 4 thEdn., Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 1994.

[2] K.K. Rohatgi-Mukherjee, Fundamentals of Photochemistry, 2ndEdn., New Age International, 1986.

[3] P. Atkins. J. Paula, Atkins Physical Chemistry, 8thEdn., Oxford University Press, 2006.

[4] B. R. Puri, L.R. Sharma, M. S. Pathania, Elements of Physical Chemistry, 40thEdn., Vishal Pub. Co., Jalandhar, 2003.

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SEMESTER 4

Course: Complimentary Chemistry

CHE4CMP04.1: ADVANCED PHYSICAL CHEMISTRY – II

(For students who have opted Physical Sciences as Main)

Module	HrsAllote d	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	12	3	2	1	6
2	8	2	1	-	3
3	5	2	1	1	4
4	12	2	2	1	5
5	11	1	2	1	4
6	6	2	1	-	3
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fourth Semester

Course: Complimentary Chemistry

CHE4CMP04.1: ADVANCED PHYSICAL CHEMISTRY – II

(For students who have opted Physical Sciences as Main)

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

PART A (Answer any 10 questions)

1. State Beer Lamberts law with equation.
2. What is meant by zero-point energy?
3. Oxidation number of Cr in $K_2Cr_2O_7$ is ………
4. What is the condition for a molecule to be I R active?
5. State Grotthus-Draper law.
6. Define molar conductivity.
7. State Faraday's first law of electrolysis.
8. What is chemiluminescence?
9. What is meant by a redox reaction?
10. If the solubility of silver chloride in water at 298K is 1.06 x 10^{-5}mol L^{-1}, find the solubility product of it at 298K.
11. What is meant by the order of a reaction?
12. Give two examples of pseudo order reactions.

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain functional group region and finger print region in IR spectroscopy.
14. Derive the integrated rate expression for first order reactions.
15. Write notes on a) Bathochromic and hypsochromicshift b) Symmetric and Assymetric stretching in CO_2 molecule.
16. Write a short note on the photosensitized reactions.
17. Explain the effect of electrolyte concentration on electrode potential and emf.
18. The same quantity of electricity was allowed to pass through three cells in series containing copper sulphate, silver nitrate and potassium iodide solutions. What weights of silver and iodine will be liberated if 2.5g of copper is being deposited?
19. State and explain Kohlausch's law. Write any two applications of it.

20. Explain oxidation and reduction in terms of electronic concept.
21. What do you meant by liquid junction potential? Describe.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Explain the applications of Microwave and IR spectroscopy in chemical analysis.
23. Explain various types of transitions occur in molecules with the help of Jablonski diagram.
24. Describe the Hittorfs method of finding the transport number of Ag^+ and NO_3^- ions.
25. What are fuel cells? Explain the working of hydrogen- oxygen fuel cell.

(2x10=20 Marks)

SEMESTER 4

CHE4CMP04.2: ADVANCED BIO- ORGANIC CHEMISTRY

(For students who have opted Biological Sciences)

Total Hrs: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE4CMP04.2	**ADVANCED BIO- ORGANIC CHEMISTRY**	L	T	P	C
		3	0	0	3
Objectives	The course promotes understanding of facts and concepts in bioorganic chemistry and develops interest in the study of biomolecules. The course covers the classification and properties of amino acids, the structure and functions of proteins and nucleic acids, ADP, ATP and AMP, classification, properties and structure of carbohydrates, classification and characteristics of enzymes and mechanism of enzyme action and fundamentals of vitamins, hormones, steroids, essential oils, lipids and alkaloids.				
Course Outcome(s)					
CO1	To understand the preparation and properties of amino acids and proteins				
CO2	To study the interaction of enzymes and nucleic acids				
CO3	To study the structure and properties of various carbohydrates				
CO4	To understand the chemistry of natural products				
CO5	To analyze the classification and estimation of lipids				

Module 1: Amino acids and proteins (12 Hrs)

Classification of amino acids, zwitter ion and isoelectric point, general chemical properties of amino acids, synthesis of glycine, alanine, phenyl alanine (anyone method). Peptides – peptide bond- dipeptides (eg. Aspartame), tripeptides (eg.Glutathione), polypeptides. Proteins- amino acids as building block of proteins, classifications, prosthetic group, properties-denaturation, tests of protein. Structure of proteins- primary, secondary, tertiary and quaternary structures.Amino acid sequence- Analysis of amino acids-N-terminal amino acid analysis –Edman method, sequenator, DNP method.C-Terminal amino acid analysis- enzymatic method (Carboxypeptidase).

Module 2: Enzymes and Nucleic acids (10 Hrs)

Enzymes – General nature, nomenclature, classification, cofactors-coenzyme, characteristics of enzyme action,mechanism of enzyme action-the lock and key model and the induced fit model, Kinetics of enzyme catalysis, factors affecting enzyme action, enzyme inhibitors, enzyme deficiency diseases, uses of enzymes.

Energy rich molecules: elementary structure of ATP, ADP and AMP, energy release by ATP and ADP.

Nucleic acids- Chemical composition, nucleosides, nucleotides.Structure of DNA & RNA. (mention only different types of bases and sugars, no structures are required). Structural biological functions - DNA replication, protein biosynthesis, coding for amino acids.

Module 3: Carbohydrates (12 Hrs)

Classification of carbohydrates, preparation, physical and chemical properties of glucose, fructose and sucrose. Configuration of glyceraldehyde- D and L configuration, Hemiacetal form, Haworth projections of D(+)glucose and D(-)fructose, sucrose and maltose (ring size determination not expected). Mutarotation, Inversion of cane sugar. Conversion of glucose to fructose and vice-versa.Structure of starch and cellulose.Industrial applications of cellulose.

Module 4: Vitamins, Steroids and Hormones (10Hrs)

Vitamins - Classification, Structure, properties, biological functions and deficiency diseases of vitamin A, B and C.

Steroids - General introduction, structure, stereochemistry and physiological importance of cholesterol and bile acids.

Hormones - Introduction, steroid hormones-sex hormones and adrenal cortex hormones, peptide hormones-insulin, oxytocin, vasopressin and angiotensin II.

Amine hormones - Adrenaline, thyroxine, artificial hormones - Anabolic streroids, Oral Contraceptives, Diethylstilbosterol and Prednisone.

(Structures are not required. Mention only functions.)

Module 5: Lipids (5 Hrs)

Classification - Simple lipids and complex lipids with examples, occurance, isolation, nomenclature, properties and biological functions of oils and fats, Rancidity, Analysis of oils and fats- acid value, saponification value and iodine value.

Soaps, types of soaps, cleaning action of soap. Detergents - anionic, cationic and non ionic detergents, superiority of detergents over soap.

Module 6: Natural Products **(5 Hrs)**

Terpenoids: classification, isoprene rule.

Essential oils - citral and geraniol –chemical properties and uses.

Alkaloids- Classification based on source, isolation, general properties, tests and physiological effects of coniine and nicotine. Structure elucidation of coniine

References

1. I. L. Finar, Organic Chemistry - Volume I, Pearson Education, 1973.
2. I. L. Finar, Organic Chemistry – Volume II, Pearson Education, 1956.
3. K. S. Tewari, N. K. Vishnoi, A Text Book of Organic chemistry, 3rd Edn., Vikas publishing House Pvt. Ltd, 2006.
4. Rastogi, Biochemistry, Tata McGraw Hill Publication,1996.
5. D. Voet, J. G. Voet, Biochemistry, 4th Edn., John Wiley and Sons, 2010.
6. O.P. Agarwal Chemistry of Natural Products, Goel Publications, 1989.

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SEMESTER 4

Course: Complimentary Chemistry

CHE4CMP04.2: ADVANCED BIO- ORGANIC CHEMISTRY

(For students who have opted Biological Sciences)

Module	HrsAllote d	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	12	3	2	1	6
2	10	3	2	1	6
3	12	3	2		5
4	10	1	2		3
5	5	1	1	1	3
6	5	1		1	2
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fourth Semester

Course: Complimentary Chemistry

CHE4CMP04.2: ADVANCED BIO- ORGANIC CHEMISTRY

(For students who have opted Biological Sciences)

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

PART A (Answer any 10 questions)

1. What are zwitter ions?
2. What are peptide bonds?
3. What are conjugated proteins? Give an example
4. What is the function of m-RNA?
5. What is a nucleoside?
6. Distinguish between haloenzyme and apoenzyme
7. Define mutarotation
8. Draw the open chain structure of glucose
9. Why sucrose is known as invert sugar?
10. What is isoprene rule?
11. What are detergents?
12. What are the four factors which affect the LDL level in the body?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain induced fit model of enzyme action
14. What are the products obtained when glucose is oxidised with mild and strong oxidizing agents? Give equations
15. Explain the structure of starch
16. Explain the cleansing action of soaps
17. Explain any five chemical properties of citral?
18. How are amino acids classified? Explain with examples
19. Explain how vitamin A helps in vision
20. What are peptide hormones? Explain their classification and functions?
21. Write any one method for the synthesis of glycine?

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Explain the biological function of nucleic acid
23. Discuss the structure of protein?
24. Elucidate the structure of coniine?
25. Give the various methods for analysis of oils?

(2x10=20 Marks)

SEMESTER 3 & 4

CHE4CP02.1: PHYSICAL CHEMISTRY PRACTICAL

(For students who have opted Physical Sciences)

Total Hrs: 36+36= 72; Credits: 2; Hrs/Week: 2; Total Marks 50 (Internal 10& External 40)

CHE4CP02.1	**PHYSICAL CHEMISTRY PRACTICAL**	L	T	P	C
		0	0	2	2
Objectives	To apply the principles of thermodynamics, kinetics etc. To gain familiarity with a variety of physic chemical measurements				
Course Outcome(s)					
CO1	To develop skill in determining the physical parameters				
CO2	To interpret data from an experiment including the construction of appropriate graphs and the evaluation of errors				

1. Molecular Weight by Victor Meyer's method.
2. Determination of partition coefficient of a nonvolatile solute.
3. Transition temperature of salt hydrates, eg: sodium thiosulphate, sodium acetate etc.
4. Critical solution temperature of phenol water system.
5. Phase diagram of two component systems.
6. Heat of Solution KNO_3, NH_4Cl.
7. Heat of neutralization.
8. Determination of equivalent conductance of an electrolyte.
9. Conductometric titration of strong acid Vs strong base.
10. Potentiometric titrations: Fe^{2+} Vs. $Cr_2O_7^{2-}$ and Fe^{2+}Vs. $KMnO_4$.
11. Determination of molecular weight by Rast's method. (using naphthalene, camphor or biphenyl as solvent and acetanilide, p–dichlorobenzene etc. as solute).
12. Kinetics of simple reactions, eg. Acid hydrolysis of methyl acetate.

References

1. W. G. Palmer, Experimental Physical Chemistry, Cambridge University Press, 1941.
2. J. B. Yadav, Advanced Practical Physical Chemistry, 9thEdn., Goel Publishing House, 1989.
3. R. C. Das and B. Behra, Experimental Physical Chemistry, Tata McGraw hill. New Delhi,1983.
4. K. K. Sharma and D.S. Sharma, Introduction to Practical Chemistry, Vikas Publishing House, New Delhi, 1989.

SCHEME OF VALUATION
SEMESTER 3 & 4

Course: Complimentary Chemistry

CHE4CP02.1: PHYSICAL CHEMISTRY PRACTICAL
(For students who have opted Physical Sciences as Main)

1. Saturated solution of I_2 will be supplied

Procedure	-	8 marks
Tabular column and data	-	6 marks
Calculation of two values of partition coefficient	-	8 marks
Partition coefficient (85-90)	-	10 marks
Viva	-	8 marks
Total	**-**	**40 marks**

(Upto 5% error 10 marks. For every additional 2% error deduct 1 mark)

2. Salt hydrates to be given: Sodium thiosulphate = 48^0C ; Sodium acetate = 58^0C)

Procedure	-	8 marks
Tabular column and data	-	6 marks
Time – Temperature graph (minimum 8 points)	-	8 marks
Transition temperature	-	10 marks
Viva	-	8 marks
Total	**-**	**40 marks**

(Upto 5% error 10 marks. For every additional 2% error deduct 1 mark)

3. A solution of 100ml molten phenol + 5 ml water can be given.

Procedure	-	8 marks
Tabular column and data	-	6 marks
Graph (minimum 6 points)	-	6 marks
Critical solution temperature (68^0C)	-	12 marks
Viva	-	8 marks
Total	**-**	**40 marks**

(Upto 5% error 12 marks. For every additional 2% error deduct 1 mark)

4. Solute to be given KNO_3 (~36 kJ/mol)

Procedure	-	8 marks
Tabular column and data	-	4 marks
Graph	-	4 marks
Calculation of water equivalent	-	4 marks
Calculation of heat of solution	-	4 marks
Correct value	-	8 marks
Viva	-	8 marks
Total	**-**	**40 marks**

(Upto 5% error 10 marks. For every additional 2% error deduct 1 mark)

5. Give exactly 0.5N, 0.75N or 1N, HCl and NaOH. Heat of neutralization = 13.6 kcal/mol or 57.3 kJ/ mol

Procedure	-	8 marks
Tabular column and data	-	4 marks
Graph	-	4 marks
Calculation of water equivalent	-	4 marks
Calculation of heat of neutralisation	-	4 marks
Correct value	-	8 marks
Viva	-	8 marks
Total	**-**	**40 marks**

(Upto 5% error 10 marks. For every additional 2% error deduct 1 mark)

6. Packets containing exactly weighed solvent (10 to 12g) and solute (0.3 to 0.6 g) should be supplied .

Solvent	M.P	Molal depression	Solution Constant K_f	Molecular mass
Camphor	178.4° C	37.7^0C	Diphenyl Amine	135.17
Naphthalene	80° C	6.9° C	Acetanilide	154.21
Diphenyl amine	52.5° C	8.6° C	Diphenyl	169.23
			Naphthalene	128.17

Procedure	-	8 marks
Tabular column and data	-	4 marks
Cooling curve of Solvent	-	5 marks
Cooling curve of Solution	-	5 marks
Calculation of molecular mass	-	4 marks
Correct value of molecular mass	-	6 marks
Viva	-	8 marks
Total	**-**	**40 marks**

(Upto 5% error 10 marks. For every additional 2% error deduct 1 mark)

7. N/10 HCI and N/10 NaOH solutions can be given

Procedure	-	8 marks
Performance and recording ...	-	6 marks
Graph	-	8 marks
Calculation	-	2 marks
Accuracy	-	8 marks
Viva	-	8 marks
Total	**-**	**40 marks**

(Upto 5% error 10 marks. For every additional 2% error deduct 1 mark)

8. N/10 $KMnO_4$ and N/10 Fe^{2+} solutions can be given

Procedure	-	8 marks
Performance and recording ...	-	6 marks
Graph	-	8 marks
Calculation	-	2 marks
Accuracy	-	8 marks
Viva	-	8 marks
Total	**-**	**40 marks**

(Upto 5% error 10 marks. For every additional 2% error deduct 1 mark)

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Semester 3 & 4

Course: Complimentary Chemistry

CHE4CP02.1: PHYSICAL CHEMISTRY PRACTICAL

(For students who have opted Physical Sciences)

Time: 3 Hrs **Total Marks: 40**

Attempt the question marked and copy down in your main answer book. Write down its procedure in 10 minutes.

1. Determine the partition coefficient of iodine between carbon tetrachloride and water.
2. Determine the transition temperature of the given salt hydrate.
3. Determine critical solution temperature (CST) of phenol-water system.
4. Determine the enthalpy (heat) of solution of the given solute in water.
5. Determine the enthalpy (heat) of neutralization of a strong acid by a strong base
6. Determine the molar mass of the given solute by Rast method. (Draw cooling curves for determining freezing point).
7. Determine the strength of the given HCl by titrating conductometrically with 0.1N NaOH.
8. Estimate the mass of ferrous iron per litre by potentiometric titration with 0.1N $KMnO_4$ solution.

SEMESTERS 3 & 4

CHE4CP02. 2: ORGANIC CHEMISTRY PRACTICAL

(For students who have opted Biological Sciences)

Total Hrs: 36+36= 72; Credits: 2; Hrs/Week: 2; Total Marks 50 (Internal 10& External 40)

CHE4CP02. 2	**ORGANIC CHEMISTRY PRACTICAL**	L	T	P	C
		0	0	2	2
Objectives	To get training for systematic qualitative analysis of simple organic compounds.				
Course Outcome(s)					
CO1	To develop skills required for the qualitative analysis of organic compounds and determination of physical constants				
CO2	To impart the students a thorough knowledge about the chemistry of some selected functional groups and to study the reactions of organic compounds.				

1. Tests for elements: Nitrogen, Halogen and Sulphur
2. Study of reactions of common functional groups.
3. Qualitative analysis with a view to characterization of functional groups and identification of the following compounds: Naphathalene, anthracene, phenol, o-, m- and p- cresols, α- naphthol, β-naphthol, resorcinol, benzaldehyde, acetophenone, benzophenone, benzoic acid, phthalic acid, cinnamic acid, salicylic acid, ethyl benzoate, methyl salicylate, benzamide, urea, aniline, N,N-dimethyl aniline, nitrobenzene, *m*-dinitrobenzene and glucose.

References:

1. A.I. Vogel, B.S. Furniss, Vogel's Textbook of Practical Organic Chemistry, Longman, 1989.
2. F. G. Mann and B.C. Saunders, Practical Organic Chemistry, 4th Edn.,Pearson Education, 2009.
3. V. K. Ahluwalia and S. Dhingra, Comprehensive Practical Organic Chemistry, Universities Press, 2004.

SCHEME OF VALUATION
SEMESTER 3 & 4
CHE4P02- ORGANIC CHEMISTRY PRACTICAL –I

1. Analyze the given organic compound qualitatively. Write down the systematic analysis of the given compound with two identification and confirmation tests.

[32]

Detection of Elements	: 4
(Nitrogen detection- 2; Halogen Detection-1; Sulphur Detection-1)	
Aromatic/ Aliphatic	: 3
Saturated/ Unsaturated	: 3
Determination of Functional Group	: 8
Confirmation tests	: 6
Systematic Recording	: 4
Derivative suggestion	: 4

2. Viva-voce **[8]**

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION

SEMESTER 3 & 4

Course: Complimentary Chemistry

CHE4CP02. 2: ORGANIC CHEMISTRY PRACTICAL

(For students who have opted Biological Sciences)

Time: 3 Hrs **Total Marks: 40**

1. Analyze the given organic compound qualitatively. Write down the systematic analysis of the given compound with two identification and confirmation tests. Suggest a suitable derivative of the given compound.

[32 Marks]

2. Viva-voce [8 Marks]

MAHARAJA’S COLLEGE, ERNAKULAM
(A Government Autonomous College)

UNDER GRADUATE PROGRAMME

IN

B. Sc CHEMISTRY- (Model III)

ENVIRONMENT AND WATER MANAGEMENT

2020

Programme Code: MCUSCCH07

B.Sc. CHEMISTRY ENVIRONMENT & WATER MANAGEMENT

CREDIT AND MARK DISTRIBUTION IN EACH SEMESTER

B.Sc. CHEMISTRY- ENVIRONMENT & WATER MANAGEMENT

	Code	Course	Hours/ week	Credit	Marks		
					Internal	External	Total
Semester 1	ENG1CMR01	Common Course- English	5	4	20	80	100
	CHE1COR01	Inorganic Chemistry - I (General Inorganic Chemistry)	2	2	20	80	100
	CHE2P01	Qualitative Inorganic Analysis	2	-	Evaluation at the end of second semester		
	ENV1COR01	Basic Concepts of Environmental Sciences	3	3	15	60	75
	ENV1COR02	Environmental Toxicology and Occupational Health	3	3	20	80	100
	ENV2P01	Physico – Chemical Analysis of Water	2	-	Evaluation at the end of second semester		
	MAT1CMP01	Complementary mathematics	4	3	20	80	100
	PHY1CMP01	Complementary Physics	2	2	20	80	100
	PHY2CP01	Complementary Physics Practical	2	-	Evaluation at the end of second semester		
	Total		**25**	**17**			**475**
Semester 2	ENG2CMR02	Common Course- English	5	4	20	80	100
	CHE2COR02	Inorganic Chemistry –II (Atomic Structure And Chemical Bonding)	2	2	15	60	75
	CHE2P01	Qualitative Inorganic Analysis	2	2	10	40	50
	ENV3COR03	Atmospheric Chemistry and Air Pollution	3	3	20	80	100
	ENV3COR04	Environmental Pollution	3	3	15	60	75
	ENV2P01	Physico – Chemical Analysis of Water	2	2	10	40	50
	MAT2CMP02	Complementary mathematics	4	3	20	80	100
	PHY2CMP02	Complementary Physics	2	2	15	60	75
	PHY2CP01	Complementary Physics Practical	2	2	10	40	50
	Total		**25**	**23**			**675**

Semester 3	CHE3COR03	Organic Chemistry -1 (Reaction Mechanism & Stereochemistry)	3	3	20	80	100
	CHE4P02	Organic Chemistry Practical –I	2	-	Evaluation at the end of fourth semester		
	ENV3COR05	Environmental Analytical Techniques	3	3	15	60	75
	ENV3COR06	Environmental Engineering	3	3	15	60	75
	ENV4P02	Physico Chemical Analysis of Soil and Effluent – I	2	-	Evaluation at the end of fourth semester		
	ENV4P03	Physico Chemical Analysis of Soil and Effluent – II	2	-	Evaluation at the end of fourth semester		
	MAT3CMP03	Complementary mathematics	5	4	20	80	100
	PHY3CMP03	Complementary Physics	3	3	15	60	75
	PHY4CP02	Complementary Physics Practical	2	-	Evaluation at the end of fourth semester		
	Total		**25**	**16**			**400**

Semester 4	CHE4COR04	Organic Chemistry –II (Functional Group Chemistry)	3	3	15	60	75
	CHE4P02	Organic Chemistry Practical–I	2	2	10	40	50
	ENV4COR07	Environmental Microbiology and Biotechnology	3	3	15	60	75
	ENV4COR08	Environmental Management	3	3	15	60	75
	ENV4P02	Physico Chemical Analysis of Soil and Effluent – I	2	2	10	40	50
	ENV4P03	Physico Chemical Analysis of Soil and Effluent – II	2	2	10	40	50
	MAT4CMP04	Complementary mathematics	5	4	20	80	100
	PHY4CMP04	Complementary Physics	3	3	15	60	75
	PHY4CP02	Complementary Physics Practical	2	2	10	40	50
	Total		**25**	**24**			**600**

Semester 5	CHE5COR05	Environmental Studies and Human Rights	3	3	20	80	100
	CHE5COR06	Organic Chemistry-III (Natural Products)	3	3	15	60	75
	CHE5COR07	Physical Chemistry- I (States Of Matter And Surface Chemistry)	2	2	15	60	75
	CHE5COR08	Physical Chemistry- II (Quantum Mechanics, Spectroscopy And Photochemistry)	3	3	15	60	75
	CHE5CBP01	Choice Based Course - I	4	4	20	80	100
	CHE6P03	Volumetric Analysis	3	-	Evaluation at the end of sixth semester		
	CHE6P04	Organic Chemistry Practical- II	2	-	Evaluation at the end of sixth semester		
	CHE6P05	Physical Chemistry Practical	3	-	Evaluation at the end of sixth semester		
	CHE6D01	Project	2	-	Evaluation at the end of sixth semester		
	Total		**25**	**15**			**425**
Semester 6	CHE6COR09	Inorganic Chemistry – III (Advanced Inorganic Chemistry)	3	3	15	60	75
	CHE6COR10	Organic Chemistry- IV (Advanced Organic Chemistry)	3	3	15	60	75
	CHE6COR11	Physical Chemistry – III (Thermodynamics And Kinetics)	3	3	15	60	75
	CHE6COR12	Physical Chemistry – IV (Solution Chemistry And Electrochemistry)	3	3	15	60	75
	CHE6CBP01	Choice Based Course - II	3	3	20	80	100
	CHE6P03	Volumetric Analysis	3	2	10	40	50
	CHE6P04	Organic Chemistry Practical- II	2	2	10	40	50
	CHE6P05	Physical Chemistry Practical	3	2	10	40	50
	CHE6P06	Gravimetric Analysis	2	2	10	40	50
	CHE6D01	Project and Viva		2	20	80	100
	Total		**25**	**25**			**700**

SEMESTER 1

CHE1COR01 – INORGANIC CHEMISTRY – I
(GENERAL INORGANIC CHEMISTRY)

Total Hrs: 36; Credits: 2; Hrs/Week: 2; Total Marks 75 (Internal 15 & External 60)

CHE1COR01	INORGANIC CHEMISTRY – I (GENERAL INORGANIC CHEMISTRY)	L*	T**	P ***	C#
		2	0	0	2
Objectives	To make the student to understand that Chemistry is a basic science subject and have major relation to other branches of science. Students will also gain better insights on the basic principles of qualitative and quantitative analyses and the periodic properties of elements.				
Course Outcome(s)					
CO1	The course will enable the student to understand the methodology of Science in general and Chemistry in particular				
CO2	This course will give foundations on the periodic properties of elements				
CO3	Make the student a good experimentalist based on understanding of fundamental analytical principles and good laboratory practices				
CO4	To inculcate skills required for qualitative and quantitative inorganic analysis				

*Lecture, **Tutorial, ***Practical, #Credit

Module 1: Methodology of Chemistry (9 Hrs)

Types of knowledge: Practical, theoretical and scientific knowledge. Definition of science. Scientific statements, Scientific methods – Hypothesis – theories and laws in science – observations, evidences and proofs, Scientific problem- induction, deduction. Falsicication of hypothesis. Revision of scientific theories and laws- (Atomic theory as example- Democrates, Dalton, J. J Thomson, Rutherford, Sommerfield, Bohr and Quantum mechanical theory). Evolution of chemistry ancient speculation on the nature of matter- early form of chemistry- origin of modern chemistry, structure of chemical science – scope, theory and experiment.

Branches of chemistry- Role of chemistry as a central science connecting physics, biology and other branches of science. Basic ideas ofinterdisciplinary areas involving chemistry- nano technology, biotechnology biochemistry, nuclear chemistry, analytical chemistry, environmental chemistry, combinatorial chemistry, medicinal chemistry, engineering chemistry.

Module 2: Chemistry of s and p block elements (9Hrs)

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

2.2 Compounds of p block elements: Boron hydrides –diborane (preparation, properties and bonding), Classification- Closo, Nido and Arachno - B_5H_9, B_4H_{10} (structure only). Closo carboranes, boron nitride, borazine, boric acid. Peroxy acids of sulfur. Oxides and oxy acids of halogens (structure only), superacids, interhalogen compounds, pseudohalogens, electropositive iodine, fluorocarbons. Fluorides, oxides and oxy fluorides of xenon (structure only).

Module 3: Chemistry of d and f block Elements (9 Hrs)

3.1. General characteristics of d-block elements with special reference to electronic configuration, oxidation states, metallic character, color, magnetic properties, catalytic properties and ability to form complexes. Comparison of the properties of second and third transition series with first transition series.

3.2. Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties, spectral properties and separation of lanthanides by ion exchange and solvent extraction methods (Brief study).

3.3. Chemistry of actinides – electronic configuration, oxidation states, actinide contraction, position of actinides in the periodic table, comparison with lanthanides in terms of magnetic properties and spectral properties (Brief study).

Module 4: Analytical Principles (9 Hrs)

4.1. Laboratory hygiene & safety-storage and handling of chemicals. Simple first aids: electric shocks, fire, cut glass, inhalation of poisonous gases, accidents due to acids and alkalies, burns due to phenol and bromine. Disposal of sodium and broken mercury thermometer – use of $CaCl_2$ & Silica gel in desiccators. Awareness of material safety datasheet (MSDS). R&S (elementary idea only). Good Laboratory Practices- Laboratory sign.

4.2. Inorganic qualitative analysis - Common ion effect, solubility product –Principle, Applications of solubility product and common ion effect in the precipitation of cations, principle and procedure of Interfering acid radicals and their elimination (oxalate, fluoride, borate, phosphate, chromate, arsenite and arsenate). Titrimetric Analysis: Molecular mass, Equivalent mass, Primary and secondary standards, quantitative dilution – problems standard solutions, Normality, molarity, molality mole fraction, ppm and ppb and related problems. Theory of titrations involving acids and bases, titration curves, $KMnO_4$, $K_2Cr_2O_7$. Indicators – Theory of acid-base, redox, adsorption indicators. Complexometric Titrations, EDTA titrations- titration curves metal ion indicators (basic theory and principle only).

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SEMESTER I

Core Course: Chemistry (Environment and Water Management)

CHE1COR01 – INORGANIC CHEMISTRY – I

(GENERAL INORGANIC CHEMISTRY)

Module	Hrs Allotted	Part A 1 Mark (Answer any 10 questions out of 12)	Part B 5 Marks (Answer any 6 questions out of 9)	Part C 10 Marks (Answer any 2 questions out of 4)	Total questions
1	9	3	3	1	7
2	9	3	2	1	6
3	9	3	2	1	6
4	9	3	2	1	6
	36	12	9	4	**25**

MODEL QUESTION PAPER
BSc DEGREE (C.B.C.S.S) EXAMINATION

First Semester

Core Course: Chemistry

CHE1COR01 – INORGANIC CHEMISTRY – I

(General Inorganic chemistry)

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

PART A (Answer any 10 questions)

1. What is meant by hypothesis?
2. What is a scientific law?
3. What is medicinal chemistry?
4. What is meant by inert pair effect?
5. What are inter-halogen compounds? Give one example
6. Give the structure of XeO_2F_2
7. Why are d-block elements known as transition elements?
8. What type of electronic transitions is dominant in transition elements?
9. Why ion-exchange methods are appropriate for separation of lanthanides?
10. What is MSDS?
11. Define common ion effect
12. Name any two adsorption indicators

(10 × 1=10 Marks)

PART B (Answer any 6 questions)

13. Explain the inductive and deductive methods of reasoning
14. Write a note on Rutherford and Bohr models of atomic structure
15. What is falsification of hypothesis? Explain with an example
16. Write a short note on (a) boron nitride and (b) borazine
17. Explain the periodic trends of ionization energy and electron affinity of s and p-block elements
18. How do first row transition elements differ from second and third row series in terms of magnetic properties and ability to form complexes?
19. Explain the effects of (a) lanthanide contraction and (b) actinide contraction
20. Write a short note on Good Laboratory Practices
21. Explain the principle of EDTA based complexometric titrations.

(6 × 5 = 30 Marks)

PART C (Answer any 2 questions)

22. Is chemistry 'The Central Science'? How are different sciences related?
23. Discuss the preparation, properties and bonding of diborane (B_2H_6).
24. Make a thorough comparison between actinides and lanthanides in terms of electronic configuration, oxidation states, magnetic and spectral properties.
25. Discuss about disposal methods of sodium and broken mercury thermometer. How do you eliminate interfering anions fluoride and phosphate in qualitative inorganic analysis?

(2 $\times$10 = 20 Marks)

SEMESTER 1

ENV1COR01– BASIC CONCEPTS OF ENVIRONMENTAL SCIENCE

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75(Internal 15 & External 60)

ENV1COR01	**BASIC CONCEPTS OF ENVIRONMENTAL SCIENCE**	L	T	P	C
		3	0	0	3
Objectives	To get a basic idea about Environmental science, biodiversity, ecology and ecosystem and natural resources.				
Course Outcome(s)					
CO1	To understand the components of environment.				
CO2	To understand the importance of ecology and ecosystems in environment				
CO3	To understand the significance of biodiversity and need for its conservation and various strategies adopted for its conservation				
CO4	To study the need for sustainable use of renewable and nonrenewable energy resources.				

Module 1: Fundamentals of Environmental Science (9Hrs)

Definition and concepts in environmental science - principles and scope of environmental science and Environmental education. Components of environment - atmosphere, hydrosphere, lithosphere and biosphere. Fundamentals of sustainable development and Environmental impact assessment. Major effects on environment- pollution, Urbanization, resource depletion. Trans boundary movements of pollutants

Module 2: Ecology and Ecosystem (9Hrs)

Ecology: Ecological studies- Autecology, Synecology. Ecosystem- concepts, structure and functions. Trophical levels - producers, consumers, decomposers. Ecological functions; Energy flow, Food chain, Food web. Concepts - pollution growth and its dynamics- growth patterns - natality, mortality intra specific and inter specific interactions - neutralism, commensalism, mutualism and parasitism. - Ecological successions - ecological pyramids, productivity in an ecosystem - primary and secondary productivity.

Module 3: Biodiversity (18Hrs)

Biodiversity, Types of Diversity. Components - alpha, beta and gamma. Values of Biodiversity, ecological and economic importance, key stone umbrella and flagship species – ecotone, edge effect, niche and hotspot. Biodiversity loss; Habitat fragmentation, Deforestation, Forest fire, Urbanization, etc. IUCN red list- threatened species, endangered species, vulnerable species, rare species, extinct species and endemic species. Biodiversity conservations - *insitu* conservation - sanctuaries - national parks-biosphere reserves - nature reserves, *ex situ* conservation, Botanical garden, germplasm and gene bank - tissue culture - pollen and sporebank, DNA bank. Biogeographical regions of India

Module 4: Natural resources (18Hrs)

Natural Resources-Forest resources, Water resources, Mineral resources, Land resources, Energy resources. Resources degradation and conservation measures. Renewable and non-Renewable energy resources. Renewable energy resources - biomass, bio fuel, hydro power, tidal energy, wave energy, wind energy, geothermal energy, solar energy, magneto hydro power, hydrogen energy and OTEC. Nonrenewable energy resources - fossil fuels and nuclear fuels.

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First Semester

Core Course: B. Sc Chemistry (Environment and Water Management)

ENV1COR 01 – BASIC CONCEPTS OF ENVIRONMENTAL SCIENCE

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	9	2	2	0	4
2	9	5	4	1	10
3	18	3	2	2	7
4	18	2	1	1	4
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

First Semester

Core Course: B. Sc Chemistry (Environment and Water Management)

ENV1COR 01 – BASIC CONCEPTS OF ENVIRONMENTAL SCIENCE

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

PART A (Answer any 10 questions)

1. Define Ecotone?
2. Define Fodweb?
3. Define Genetic diversity?
4. Define Hydrosphere?
5. Define Hot spots?
6. Define Energy pyramid?
7. Define OTEC?
8. Define Renewable energy resources?
9. Define Succession?
10. Define Trophical level?
11. Define Autecology?
12. Define Sustainable development? **(10x1=10 Marks)**

PART B (Answer any 6 questions)

13. Explain Ecological pyramids?
14. Write note on Ecological succession?
15. Explain values of biodiversity?
16. Write note on Insitu conservation?
17. Write note on Renewable energy resources?
18. Explain Terrestrial Ecosystems?
19. Explain scope of Environmental studies?
20. Write briefly on components of Environment?
21. Explain structure and Functions of Ecosystems?

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Write Essay on Ecosystems and types of Ecosystems?
23. Write essay on Natural resources?
24. Write Brief note on Biodiversity and its Conservation?
25. Write Essay on Biogeographical regions of India?

(2x10=20 Marks)

SEMESTER 1

ENV1COR02- ENVIRONMENTAL TOXICOLOGY & OCCUPATIONAL HEALTH

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

ENV1COR02	**ENVIONMENTAL TOXICOLOGY & OCCUPATIONAL HEALTH**	L	T	P	C
		3	0	0	3
Objectives	To understand the fundamentals of environmental toxicology and occupational health				
Course Outcome(s):					
CO1	To identify the scope of environmental toxicology in our life				
CO2	To interpret the harmful effects of organic and inorganic toxins in our body.				
CO3	To find out the mechanism of toxicants inside the body.				
CO4	To understand the concept of occupational health and safety and the role of occupational health and safety professionals in working and living environments				

Module 1: Fundamentals of toxicology (9Hrs)

Definition of toxicology - branches of toxicology and its importance environmental toxicology - principles of toxicology – toxicants and their classifications. Categories of toxic effects - factors influencing toxicity – toxic effects due to combination of chemicals - dose response relationship.

Module 2: Toxins in environment (18Hrs)

Organic and inorganic toxicants - entry into the environment - cycles and residence time - toxicity of pesticides - organo chlorine, organo phosphate and carbamides - insecticides, heavy metals, arsenic and fluorine in ground water, radioactive substance and fertilizers.

Module 3: Mode of action of toxicants (9Hrs)

Mechanism of pollutants in degradable and nondegradable toxic substances – bio transformation of toxicants - bio accumulation of xenobiotics - bio concentration and bio magnification - toxicity tests: LD50 and LC50. Fate and transport of toxicants.

Module 4: Occupational health (18Hrs)

Principles and methods of occupational health - relationship of occupation with hygiene, safety and diseases - health maintenances - survey analysis and recommendation regarding health and safety problems in working and living environments.

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SEMESTER 1

Core Course: Chemistry, Environment and Water Management

ENV1COR02- ENVIRONMENTAL TOXICOLOGY & OCCUPATIONAL HEALTH

Module	Hrs Alloted	Part A 2 Marks 10/12	Part B 5 Marks 6/9	Part C 15 Marks 2/4	Total questions
1	9	3	3	1	7
2	18	4	3	1	8
3	9	2	2	1	5
4	18	3	1	1	5
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

First Semester

Core Course: B. Sc Chemistry (Environment and Water Management)

ENV1COR 02 –ENVIRONMENTAL TOXICOLOGY & OCCUPATIONAL HEALTH

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

PART A (Answer any 10 questions)

1. Define environmental toxicology.
2. Which is the day for safety and health at work?
3. Define bioaccumulation.
4. Define LD50.
5. What is hazard assessment?
6. What are the toxic effects due to combination of chemicals?
7. What are the factors affecting toxicity?
8. What is minamata tragedy?
9. What is the chronic effect of organophosphate intoxication?
10. What is occupational toxicology?
11. What are the sources of arsenic in ground water?
12. Differentiate acute and chronic toxicity. **(10x2=20 Marks)**

PART B (Answer any 6 questions)

13. Explain the categories of toxic effects.
14. Explain biomagnifications with example.
15. Give the objectives of occupational safety and health.
16. Explain the toxic effects of organo chlorine pesticides.
17. Explain the relevance of toxicology.
18. Explain the impact of fluoride contamination in ground water.
19. Explain biotransformation of toxicants.
20. Point out the key principles involved in occupational health.
21. Explain dose response relationship with the help of a diagram.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Explain the scope of toxicology.
23. Explain the fate and transport of toxicants.
24. Explain biochemical effects of heavy metals.
25. Explain the role and responsibilities of occupational health and safety professionals.

(2x15=30 Marks)

SEMESTER 2

CHE2COR02: INORGANIC CHEMISTRY –II
(ATOMIC STRUCTURE, CHEMICAL BONDING AND BASIC COORDINATION CHEMISTRY)

Total Hrs: 36; Credits: 2; Hrs/Week: 2; Total Marks: 75 (Internal 15 &External 60)

CHE2COR02	**INORGANIC CHEMISTRY –II** (ATOMIC STRUCTURE, CHEMICAL BONDING AND BASIC COORDINATION CHEMISTRY)	L	T	P	C
		2	0	0	2
Objectives	To introduce the students to the emergence of quantum theory based models to explain the atomic structure and chemical bonding. One module is devoted for a thorough understanding of various theoretical models for describing the shape and bonding of molecules and metals. Another module is designed for acquiring basic concepts of coordination chemistry, naming of complexes, structure as well as their stereochemistry.				
Course Outcome(s)					
CO1	This course gives the student the salient features of the quantum mechanical model of the atom.				
CO2	This course gives the student to acquaint with different types of bonds and different types of hybridization and other useful theories of bonding				
CO3	At the end of the course the students will able to familiarize with different weak intra and inter molecular forces				
CO4	This course gives a thorough understanding the basic ideas of coordination compounds				
CO5	Enable the students to understand the isomerism in metal complexes				
CO6	Provides the knowledge of basic theories of coordination compounds				

Module 1: Atomic Structure **(9 Hrs.)**

Bohr model of hydrogen atom, Bohr's equation for the energy of electron in hydrogen atom, derivation of Bohr radius, velocity, energy of hydrogen atom, the hydrogen spectrum, limitations of Bohr theory. Photoelectric effect, idea of de Broglie matter waves, Heisenberg's uncertainty principle and its significance, Schrodinger wave equation (derivation not expected), wave functions, significance of Ψ and Ψ^2. Operators - Laplacian and Hamiltonian operators. Atomic orbitals, nodal planes in atomic orbitals, quantum numbers (n, l, m). Zeeman effect, Stern- Gerlac experiment, spin quantum number (s). Shapes of s, p and d orbitals. Aufbau and Pauli's exclusion principles, Hund's rule, energy level diagram of a multi electron atom. Concept of effective nuclear charge, Slater's rules and applications. Electronic configuration of atoms.

Module 2: Chemical Bonding (18 Hrs.)

2.1. Ionic bond – nature of ionic bond, properties of ionic compounds, radius ratio and coordination number, factors favoring the formation of ionic compounds. Lattice energy, Born Lande equation with derivation, factors affecting lattice enthalpy, Born-Haber cycle and its applications, solvation enthalpy and solubility of ionic compounds.

2.2. Covalent bond- valence bond theory and its limitations, concept of resonance, resonance energy, hybridisation and shapes of simple molecules (BeF_2, PCl_3, PCl_5, SF_6, CH_4, NH_3, BF_3, H_2O, NH_4^+ and IF_7 ethane, ethene and ethyne), VSEPR theory, shapes of molecules and ions (NH_3, CCl_4, H_2O, SF_6, XeF_2, XeF_4, XeF_6, CIF_3, NH_4^+, H_3O^+). Molecular orbital theory – LCAO method, molecular orbital energy diagram and properties of homo and hetero diatomic molecules (H_2, He_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, CO and NO), comparison of bond strength and bond energy and magnetic behavior of O_2, O_2^+, O_2^{2+}, O_2^- and O_2^{2-}. Polarisation of covalent bond, polarizing power and polarisability of ions, Fajan's rule. Dipole moment and molecular structure – percentage of ionic character from dipole moment.

2.3. Metallic bonding – free electron theory, valence bond theory and band theory, explanation of weak chemical forces – hydrogen bond, inter and intra molecular hydrogen bonds, effects of hydrogen bonding, van der Waals forces- ion-dipole, dipole-dipole, ion –induced dipole, dipole – induced dipole and induced dipole- induced dipole interactions.

Module 3: Coordination Chemistry (9 Hrs.)

Coordination complex, ligands and their classification, IUPAC nomenclature, coordination number, geometry of complexes with coordination numbers 4 and 6. Stability of complexes - factors affecting the stability of metal complexes. Chelates, chelate effect, stepwise stability constant and overall stability constant. Isomerism in coordination compounds – structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers. Bonding theories –Werner's theory of coordination, EAN, Valence bond theory, geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations.

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Further Reading

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SEMESTER II

Core Course: Chemistry, Environment and Water Management

CHE2COR02: INORGANIC CHEMISTRY –II

(ATOMIC STRUCTURE, CHEMICAL BONDING AND BASIC COORDINATION CHEMISTRY)

Module	Hrs. Allotted	Part A 1 Mark (Answer any 10 questions out of 12)	Part B 5 Marks (Answer any 6 questions out of 9)	Part C 10 Marks (Answer any 2 questions out of 4)	Total questions
1	9	3	2	1	6
2	18	6	5	2	13
3	9	3	2	1	6
	36	12	9	4	**25**

MODEL QUESTION PAPER

BSc DEGREE (C.B.C.S.S) EXAMINATION

Second Semester

Core Course: Chemistry (Environment and Water Management)

CHE2COR02: INORGANIC CHEMISTRY – II

(Atomic Structure, Chemical Bonding and Basic Coordination Chemistry)

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

PART A (Answer any 10 questions)

1. Write down the time-independent Schrodinger wave equation
2. Give the de Broglie matter wave equation
3. Write the electronic configuration of chromium (Z = 24).
4. Define lattice energy
5. What is the hybridization of N-atom in NH_4^+ and NH_3?
6. Give an example for a system having intra molecular hydrogen bonding
7. What is meant by polarization of covalent bond?
8. Arrange O_2, O_2^+, and O_2^{2+} in the order of bond strength
9. What is Fajan's rule?
10. Calculate the EAN of $Fe(CN)_6]^{3-}$
11. What is meant by chelate effect?
12. Give the IUPAC naming of (a) $[CoCl(NH_3)_5]Cl$ and (b) $K_2[PdCl_4]$

(10 × 1 = 10 Marks)

PART B (Answer any 6 questions)

13. Explain Slater's rule and its application
14. Write a short note on Stern-Gerlac experiment
15. Using VSEPR theory explain the shape of (a) XeF_4 and (b) CIF_3
16. Write short note on (a) Dipole moment and (b) Polarization of covalent bond
17. Give a short note on van der Waals forces
18. Discuss the hybridization scheme of PCl_3 and IF_7
19. What is LCAO method? Discuss the MO scheme of CO molecule.
20. Explain the geometry of a six-coordination complex on the basis of VB theory
21. Explain the various factors affecting the stability of metal complexes

(6 × 5 = 30 Marks)

PART C (Answer any 2 questions)

22. Derive an equation for the energy of an electron in hydrogen atom

23. (a) Derive the Born Lande equation (b) Explain Born-Haber cycle

24. Explain the free electron theory and band theory of metals

25. Discuss about the types of isomerism in co-ordination complexes

(2 × 10 = 20 Marks)

SEMESTER 2

ENV2COR03– ATMOSPHEIC CHEMISTRY&AIR POLLUTION

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 100(Internal 20& External 80)

ENV2COR03	**ATMOSPHEIC CHEMISTRY&AIR POLLUTION**	L	T	P	C
		3	0	0	3
Objectives	To understand the fundamentals of meteorology and the factors affecting it				
Course Outcome(s) :					
CO1	To find out how the meteorological factors alter the climate				
CO2	To understand the composition, structure of atmosphere and chemistry of atmospheric pollutants.				
CO3	To discuss the role of air pollution in causing the global environmental problem like global warming, ozone depletion and photochemical smog				
CO4	To recognize various measures to sample and analyze the atmospheric pollutants				

Module 1: Weather and climate (9Hrs)

Basic concepts - weather and climate - meteorological factors affecting climateweatherand climate monitoring equipments - meteorological data collection -energy of atmosphere - earth heat balance - air sea interactions - *el nino* and *la nina*effects - climate change - causes and effects, regional scenarios in climate change.

Module 2: Introduction to atmosphere (9Hrs)

Black body radiation - radiation loss - composition of atmosphere and structure, chemical composition of earth's atmosphere - major and minor constituents -vertical structure radiation balance - temperature regulation in thermosphere, stratosphere and troposphere. Radiation balance and greenhouse effect–global warming

Module 3: Atmospheric chemistry (18Hrs)

Biogeochemical cycles of carbon, oxygen, nitrogen, and sulphur cycles – halogen and trace elements cycle. Photochemical processes - photo dissociation andionization reaction of chemically excited species - formation, growth andtransformation of aerosols - species formation. Physical and chemical properties ofaerosols- cloud interaction. Stratospheric chemistry - Chapman model – chemicalmechanism of polar ozone depletion - anthropogenic impacts - oxygen onlychemistry - consequences of ozone perturbations - ozone variations and trend

Module 4: Air pollution (18Hrs)

Effects of atmospheric pollution - global warming and greenhouse effect – acidrain - ozone layer depletion - cause and consequences, primary and secondarypollutants - photochemical smog - particulates composition and health effects. Airpollution accidents - Bhopal gas tragedy and Chernobyl disaster. Air qualitystandards - sampling and analysis of atmospheric pollutants - cascade impacters -electrostatic precipitators - thermo precipitators - cold trapping. Sampling andanalysis of CO, hydrocarbons and suspended particulate matters.

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SEMESTER II

PROGRAMME: B.Sc. CHEMISTRY (Envt. & Water Management)

ENV2COR03– ATMOSPHEIC CHEMISTRY&AIR POLLUTION

Module	HrsAlloted	Part A 2 Marks 10/12	Part B 5 Marks 6/9	Part C 15 Marks 2/4	Total questions
1	9	3	2	1	6
2	9	2	1	1	4
3	18	4	3	1	8
4	18	3	3	1	7
					25

MODEL QUESTION PAPER

BSc DEGREE (C.B.C.S.S) EXAMINATION

Second Semester

Core Course: Chemistry (Envt. & Water Management)

ENV2COR03: ATMOSPHERIC CHEMISTRY & AIR POLLUTION

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

PART A (Answer any 10 questions)

1. Define weather and climate
2. What do you mean by a black body radiation?
3. What are the consequences of ozone perturbation?
4. What is greenhouse effect?
5. What are the causes of climate change?
6. What are primary pollutants?
7. What is an electrostatic precipitator?
8. Name climate monitoring equipments.
9. What is relative humidity?
10. What is temperature inversion?
11. What are minor amd major constituents of atmosphere?
12. What is acid rain?

(10x2=10 Marks)

PART B (Answer any 6 questions)

13. Explain Elnino and Lanina effects.
14. Explain windrose with the help of a diagram and its application.
15. What is the consequence of global warming?
16. Explain photochemical smog.
17. Write a note on stratospheric chemistry.
18. Explain physical and chemical properties of aerosols.
19. Discuss air pollution accidents.
20. Tropospheric ozone is a curse while stratospheric ozone is a boon discuss.
21. Explain the effects of atmospheric pollutants. **(6x5=30 Marks)**

PART C (Answer any 2 questions)

22. Explain meerological factors affecting climate change.
23. Explain the structure of atmosphere and the temperature regulation in its layers.
24. Explain biogeochemical cycles.
25. Explain the sampling and analysis of atmospheric pollutants.

(2x15=30 Marks)

SEMESTER 2

ENV2COR04– ENVIRONMENTAL POLLUTION

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75(Internal 15 & External 60)

ENV2COR04	ENVIONMENTAL POLLUTION	L	T	P	C
		3	0	0	3
Objectives	To understand the impacts of environmental pollution.				
Course Outcome(s): At the end of the course the students can					
CO1	Identify various source of water pollution- surface water, ground water and marine pollution and its control measures				
CO2	Understand the sources of soil and noise pollution and the remedial measures to control the pollution				
CO3	Find out the harmful effects of thermal and radioactive pollution and its control measures				

Module 1: Marine coastal and estuarine pollution (18 Hrs)

Definition and significance. Types of water pollution - point and non point source of water pollution - surface and groundwater pollution. Sources of water pollution - domestic, industrial, agricultural and natural sources. Impact of water pollution on human being, animals, plants and environment. Eutrophication - control measures of water pollution. Marine pollution - definition, sources of marine pollution - natural and anthropogenic sources. Control measures of marine pollution. Pollution status of coastal and ocean waters. Oil pollution - sources - effects and control measures. Coastal zone management.

Module 2: Soil Pollution (9 Hrs)

Types of soil, salt affected soil, sources of soil pollution - natural sources and anthropogenic sources - agricultural practices, industrial and municipal discharges, municipal solid waste dumping, land fill leachates, plastics, radioactive leakage, mining activities and electronic wastes. Absorption of toxic metals in soil. Salt stress in soil. Impact of soil / land pollution. Soil fertility - redox reactions in soils. Effects of industrial & urban waste - effect of modern agro technology, multi cropping – effects of soil pollution in plants and animals - control measures.

Module 3: Noise Pollution (9Hrs)

Definition and concept of Noise pollution. Sources of noise pollution - Indoor and outdoor noise pollution, natural and anthropogenic sources. Measurement of noise - unit of sound - noise level - sound power. Silence zone, ambient air quality standards for noise. Impact of noise pollution on plants and animals. Control measures adopted for abatement of noise pollution. Noise pollution analyser

Module 4: Thermal and Radioactive Pollution (18 Hrs)

Thermal and nuclear power plants as source of thermal pollution. Impacts of thermal pollution on aquatic fauna and flora. Controlling measures of thermal pollution**.** Radioactive pollution - types of radiation. Sources of Radioactivity natural and anthropogenic sources, nuclear test race and chronic radiation pollution, radio waste generated from nuclear power plant, classification and effects of radiation - biological effects of radiations, protection and control from radiation.

Disposal of radioactive waste - radioactive pollution episodes.

References

[1]. Dhara S.S., (1993). A Text book on environmental chemistry and pollution control, S Chand Publishers, New Delhi.
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BLUE PRINT OF QUESTION PAPER
Second Semester
Core Course: Chemistry, Environment and Water Management
ENV2 COR04 – ENVIRONMENTAL POLLUTION

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	3	3	1	7
2	9	4	3	1	8
3	9	3	2	1	6
4	18	2	1	1	4
					25

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION
Second Semester
Core Course: Chemistry, Environment and Water Management
ENV2COR04 – ENVIRONMENTAL POLLUTION

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

PART A (Answer any 10 questions)

1. Define Pollution?
2. Define Effluent?
3. Name two sources of Marine pollution?
4. Define solid waste?
5. Define Multicropping?
6. Define salt stress?
7. Name two types of soil?
8. Define Noise pollution?
9. Define Silence Zone?
10. Define tolerable noise level for human?
11. Define Radiation?
12. Define Thermal pollution?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain Effect of modern agro technology?
14. Write note on Eutrophication?
15. Explain Effects of fertilizer?
16. Write note on oil pollution?
17. Write note ambient air quality?
18. Explain coastal zone management?
19. Explain types of soil?
20. Write briefly on sources of Noise pollution?
21. Explain biological effect radiation?

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Write Essay on Marine pollution and control measures?
23. Write essay on Thermal pollution?
24. Write Brief note on Noise pollution and its sources?
25. Write Essay on Effects of soil pollution?

(2x10=20 Marks)

SEMESTERS 1 & 2

PRACTICAL: CHE2P01 - VOLUMETRIC ANALYSIS

Total Hrs: 36+36=72; Credits: 2; Hrs/Wk: 2; Total Marks 50 (Internal 10 &External 40)

CHE2P01	**VOLUMETRIC ANALYSIS PRACTICAL**	L	T	P	C
		0	0	2	2
Objectives	Experimental practice of quantitative volumetric analysis. To determine the amount of a substance in a given sample. To get familiarize with the concept of concentration of solutions				
Course Outcome(s)					
CO1	To develop skills for quantitative estimation using the different branches of volumetric analysis.				
CO2	To facilitate the students to make solutions of various molar concentrations.				

General Instructions

1. Use safety coat, goggles, shoes and gloves in the laboratory.
2. For weighing electronic balance may be used.
3. Double titration method may be used for volumetric titrations
4. Experiments may be selected in such a way that preference may be given for Modules I and II.
5. A minimum number of, two experiments from module III.
6. A total of 14 experiments must be done from Modules I to V to appear for the examination.
7. Practical examination will be conducted at the end of semester II.

I. Acidimetry and alkalimetry

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

II. Permanganometry

1. Estimation of Ferrous iron
2. Estimation of Oxalic acid
3. Estimation of Hydrogen Peroxide
4. Estimation of Calcium

III. Dichrometry

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

IV. Iodometry and Iodimetry

1. Standardisation of thiosulphate using KIO_3, electrolytic copper and potassium dichromate.
2. Estimation of As_2O_3 and arsenite.
3. Estimation of Cu in a copper salt.

V. Complexometry

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

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SCHEME OF VALUATION
First &Second Semester
Core Course: Chemistry (Envt. & Water Management)
PRACTICAL: CHE2P01 - VOLUMETRIC ANALYSIS

No.	Mark Division	Total marks
1	Presenting data- 3 Calculation- 2 Accuracy upto 1%- 24 Marks (1.6-2: Deduct 1 mark for each 0.1 % 2.1-2.5: Deduct 2 mark for each 0.1 % Above 2.5%: 8 marks)	**29**
2	Principle-1 Procedure-3	**4**
3	Molecular mass and Equation- 1 Substitution and Result-1	**2**
4	Viva Voce	**5**

MODEL QUESTION PAPER

BSc DEGREE (C.B.C.S.S) EXAMINATION

First &Second Semester

Core Course: Chemistry (Envt. & Water Management)

PRACTICAL: CHE2P01 - VOLUMETRIC ANALYSIS

Time: 3 Hrs. **Total Marks: 40**

1. Estimate volumetrically the mass of ……………. in the whole of the given solution. You are supplied with an approximately ……………. solution of …………… and pure ……….. crystals. **(29Marks)**
2. Write the principle and procedure for the estimation as required in Q.1 **(4 Marks)**
3. Calculate the mass of ………….. you have to weigh out accurately to prepare ………….. ml of ….. solution for Q.1 **(2 Marks)**
4. Viva voce **(5Marks)**

(Submit answer 2 and 3 within 10 minutes.)

SEMESTERS 1 & 2

ENV2P01- PHYSICO CHEMICAL ANALYSIS OF WATER

Total Hrs: 36+36= 72; Credits: 2; Hrs/Wk: 2; Total Marks 50 (Internal 10& External 40)

ENV2P01	**Physico chemical analysis of water**	L*	T**	P ***	C#
		0	0	2	2
Objectives	Experimental practice of water quality analysis To understand physico chemical parameters of water and its and analytical techniques				
Course Outcome(s):					
CO1	Toanalyze various parameters determining quality of water.				
CO2	To compare the pollution status of different sources of water.				
CO3	To attain skill in handling simple equipments in water quality analysis and to understand their working principle.				

General Instructions

1. Use safety coat, goggles, shoes and gloves in the laboratory.
2. For weighing electronic balance may be used.
3. Double titration method may be used for volumetric titrations
4. A total of 10 experiments must be done from module I and 3 instruments from module III to appear for the examination.
5. Practical examination will be conducted at the end of semester II.

Module I: Water Quality Analysis

1. Determination of pH
2. Determination of electrical conductivity
3. Determination of turbidity
4. Determination of total suspended solids
5. Determination of total dissolved solids
6. Determination of total solids
7. Determination of alkalinity
8. Determination of acidity
9. Estimation of total hardness
10. Estimation of calcium and magnesium hardness
11. Determination of chloride

12. Estimation of salinity (Argentometric method)
13. Determination of dissolved oxygen.

Module II Meteorological Analysis

1. Wind rose diagram

Module III Instrumentation

1. PH meter
2. Conductivity meter
3. Turbidity meter
4. Lux meter
5. Wet and dry bulb thermometer
6. BOD incubator

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1. K Grasshoff. K, Ehrhardt. M and K Kremling. K., (1999). Methods of Seawater Analysis.3rdEdn. Wiley – VCH.[2].
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SCHEME OF VALUATION
SEMESTER 1 & 2
Core Course: Chemistry (Envt. & Water Management)
ENV2P01- PHYSICO CHEMICAL ANALYSIS OF WATER

No	Experiments	Mark division	Marks
1	Minor experiment module I	Principle -1 Procedure -1 Accuracy up to 1%- 6 marks. Deduct one mark for each 0.2% above 2%- 2 marks Observation &Result -2	10
2	Major experiment module I	Principle -1 Procedure -1 Accuracy up to 2 % 16 marks. Deduct one mark for each 0.2 % above 3% 5 marks Observation &Result -2	20
3	Instrument module III	Working principle- 4 Diagram- 1	5
4	Viva voce Module I, II &III	5	5

MODEL QUESTION PAPER
BSc DEGREE (C.B.C.S.S) EXAMINATION
SEMESTER 1 & 2
Core Course: Chemistry (Envt. & Water Management)
ENV2P01- PHYSICO CHEMICAL ANALYSIS OF WATER

Time: 3 Hrs. **Total Marks: 40**

1. Estimate the alkalinity of given water sample (minor experiment)

   (10 Marks)
2. Estimate the Dissolved oxygen in given water sample (major experiment)

   (20 Marks)
3. Explain the working principle of any of the instruments **(5 Marks)**
   a) PH meter
   b) Wet and dry bulb thermometer
4. Viva Voce **(5 Marks)**

SEMESTER 3

CHE3COR03– ORGANIC CHEMISTRY -1
(REACTION MECHANISM & STEREOCHEMISTRY)

Total Hrs: 54; Credits: 3; Hrs/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE3COR03	ORGANIC CHEMISTRY -1 (REACTION MECHANISM & STEREOCHEMISTRY)	L	T	P	C
		3	0	0	3
Objectives	To enable the students to analyze basic theory and concepts of organic chemistry and appreciate different organic reaction mechanism and their stereochemistry.				
Course Outcome(s)					
CO1	To understand the classification and nomenclature of organic compounds.				
CO2	To understand the fundamentals of organic reaction mechanisms				
CO3	To know about stereochemistry in organic compounds				
CO4	To appreciate the stability of aromatic systems and their reaction mechanisms				

Module 1: Basic concepts of reaction mechanism **(18 Hrs)**

1.1 ***Classification and nomenclature of organic compounds***

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

1.2 ***Fundamentals of organic reaction mechanism***

Meaning of reaction mechanism: Curved arrow notation. Half headed and double headed arrows.

Electron displacement effects: inductive, inductomeric, electromeric, mesomeric, hyper conjugation and steric effects.

Nature of bond fission: Homolysis and Heterolysis. Types of reagents– Electrophiles and Nucleophiles.

Reactive intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes (structure, formation and stability).

Types of organic reactions: Definition and at least one example of each – substitution, addition, elimination and rearrangement.

Aliphatic nucleophilic substitutions: Mechanisms of S_N1 and S_N2. Effect of substrate, solvent, nucleophile and leaving groups. Stereochemistry- Walden inversion.

Elimination Reactions: Hoffmann and Saytzeff rules, cis and trans eliminations, mechanisms of E1 and E2 reactions. Elimination versus substitution.

Addition reactions: Addition of halogens and hydrogen halides. Mechanisms of addition of Br_2 and hydrogen halides to double bonds- Markownikoff's rule and peroxide effect. Test for unsaturation - Bromine water, Bromine in CCl_4 and Baeyer's reagent. 1,4 - addition in butadienes.

Module 2: Stereochemistry **(18 Hrs)**

2.1 Stereoisomerism - definition - classification into optical and geometrical isomerism

2.2 Optical isomerism - Optical activity - optical and specific rotations - conditions for optical activity - asymmetric centre - Elements of symmetry, chirality - achiral molecules - Projection formulae - Fischer, flying wedge, sawhorse and Newman projection formulae. Meaning of (+) and (-) - notation of optical isomers –D, L notation- Cahn-Ingold-Prelog rules – R,S notations for optical isomers with one and two asymmetric carbon atoms - erythro and threo representations. Enantiomers, Optical isomerism in glyceraldehyde, lactic acid and tartaric acid - Diastereomers - Meso compounds.

2.3 Racemisation - methods of racemisation (by substitution and tautomerism) - Resolution - methods of resolution (mechanical, seeding, biochemical and conversion to diastereoisomers) - Asymmetric synthesis (partial and absolute synthesis). Enantiomeric excess.

2.4 Geometrical isomerism - Cis-trans, syn-anti and E-Z notations - geometrical isomerism in maleic and fumaric acids and unsymmetrical ketoximes - methods of distinguishing geometrical isomers using melting point, dipole moment, dehydration and cyclisation.

2.5 Conformational analysis - Introduction of terms - conformers, configuration, dihedral angle, torsional strain - Conformational analysis of ethane and n-butane including energy diagrams. Origin of ring strain in cyclic systems- Baeyer's starin theory, Cycloalkanes- relative stabilities. Conformers of cyclohexane (chair, boat and skew boat forms) - axial and equatorial bonds- ring flipping showing axial equatorial interconversions, conformation of methylcyclohexane.

Module 3: Aromaticity (18 Hrs)

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

3.2 Benzene: Molecular orbital picture and resonance energy. Preparation of benzene from phenol, by oxylation, from acetylene and from aromatic acids.

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

3.4 Aromatic nucleophilic substitutions- bimolecular displacement mechanism-Addition-elimination mechanism (S_NAr mechanism) and Elimination – addition mechanism (Benzyne mechanism).

3.5 Polynuclear hydrocarbons: - Classification. Molecular orbital picture and resonance energy of naphthalene and anthracene. Preparation, reactions- electrophilic substitution (halogenations, nitration and sulfonation) of naphthalene.

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8. C.N. Pillai, Organic Chemistry, Universities Press, 2008.

Further Reading

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3. S.M. Mukherji and S.P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan, 1984.
4. R. Bruckner, Advanced Organic Chemistry: Reaction Mechanisms, Academic Press, 2001.
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SEMESTER III

Core Course: Chemistry (Envt. & Water Management)

CHE3COR03– ORGANIC CHEMISTRY -1

(Reaction Mechanism & Stereochemistry)

Module	**Hrs Allotted**	**Part A 1 Mark 10/12**	**Part B 5 Marks 6/9**	**Part C 10 Marks 2/4**	**Total questions**
1	18	4	3	1	8
2	18	4	3	1	8
3	18	4	3	2	9
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Third Semester

Core Course: Chemistry (Envt. & Water Management)

CHE3COR03– ORGANIC CHEMISTRY -1

(Reaction Mechanism & Stereochemistry)

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

PART A (Answer any 10 questions)

1. Give one example each for conjugated and isolated dienes
2. Draw the structure of maleic and fumaric acid
3. Applying Huckel's rule write whether Tropylium cation is aromatic or nonaromatic
4. Define Walden inversion
5. What is dihedral angle in conformational analysis
6. Write two examples for meta directing group
7. Hoffmann rule for elimination reaction
8. Define Write the intermediate obtained when a bond undergoes homolytic fission
9. Draw the structure of two nonbenzenoid aromatic compounds
10. Write any two elements of symmetry.
11. Give reason for the optical inactivity of meso tartaric acid
12. Which is more reactive naphthalene or benzene? Why?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Write the mechanism of halogenation and sulphonation of benzene
14. Briefly explain the conformational analysis of n-butane
15. What are the factors which effect aliphatic nucleophilic substitution reaction? Explain
16. Write the structure and formation of carbocation and carbanion
17. Explain benzyne mechanism
18. Hydroxyl group is ortho and para directing and nitro group is meta directing. Explain using resonance
19. Explain briefly the methods used to distinguish between geometrical isomers
20. Give brief account of asymmetric synthesis and resolution
21. With the help of molecular orbital theory explain the structure and bonding in benzene

(6x5=30 Marks)

PART C (Answer any 2 questions)

22 a) Explain stereochemistry of tartaric acid

b) Explain the conformational analysis of cyclohexane

23. Explain various electron displacement effects.

24 Write the structure and reactions of naphthalene anthracene and phenanthracene

25. Explain the aromaticity shown by benzenoid and nonbenzenoid compounds

(2x10=20 Marks)

SEMESTER 3

ENV3COR05: ENVIRONMENTAL ANALYTICAL TECHNIQUES

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75(Internal 15 & External 60)

ENV2COR05	**ENVIRONMENTAL ANALYTICAL TECHNIQUES**	L	T	P	C
		3	0	0	3
Objectives	To provide basic understanding about environmental sampling and analytical techniques				
Course Outcome(s):					
CO1	To understand the methods and measures adopted to conduct a sampling in a water body and can identify various water quality parameters determining the quality of water from different sources.				
CO2	To get an elementary idea regarding spectroscopic techniques and working principles of spectrophotometers and flame photometer.				
CO3	To recall the simple chromatographic techniques and understand the working principles of HPLC and GC.				
CO4	To get knowledge on the significance of biostatic observational studies on analyzing sampled data.				

Module 1: Sampling and analysis **(9 Hrs)**

Sampling: Concepts of sampling; types of sampling - random and nonrandomsampling. Sampling criteria - protocols in water, sediments and biological samples- types of samples - water and sediments - sample preservation strategies. Analysisof trace metals in water, sediment and biological samples. Important water qualityparameters DO, BOD, COD, salinity, nutrients and alkalinity.

Module 2: Spectrophotometry **(9 Hrs)**

Fundamental laws of photometry. Instrumentation of photometers – flamephotometry, detection and estimation of Na^+, K^+, Li^+ and Ca^{2+} - flame emissionspectrophotometry. Atomic absorption spectrophotometry - principles andinstrumentation, cold vapour techniques for mercury estimation. Atomicfluorescence spectrophotometry - inductively couple plasma analysis – basicinstrumentation of UV spectrophotometer

Module 3: Chromatographic techniques **(18 Hrs)**

Classification of chromatographic techniques - experimental techniques andapplication of ion exchange, column, thin layer and paper chromatography. HPLCand GC - principle, instrumentation - detectors and applications.

Module 4: Biostatistics **(18 Hrs)**

Scope of biostatic observational studies - experimental studies - explanation andpresentation of data scales of measurement. Population and samples, tabulation ofdata, frequency tables and frequency curves. Mean, mode and median; variance andstandard deviation. Tables, graphs – histograms - box viscor plot - scatter plots -confidence limits. Types of errors, p – values, ANOVA one way, two waycorrelations and regression - Pearson's correlation coefficients – regressionequation - prediction with regression equation

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[1]. Grasshoff. K, Ehrhardt. M and Kremling K., (1999). Methods of SeawaterAnalyses. 3rd Edn Wiley - VCH

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SEMESTER III

PROGRAMME: B.Sc. Chemistry- Envt. &Water Management

ENV3COR05: ENVIRONMENTAL ANALYTICAL TECHNIQUES

Module	HrsAlloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	9	3	2	1	6
2	9	2	2	1	5
3	18	3	3	1	7
4	18	4	2	1	7
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Third Semester

Core Course: B Sc Chemistry (Environment & Water Management)

ENV3COR05: ENVIRONMENTAL ANALYTICAL TECHNIQUES

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

PART A (Answer any 10 questions)

1. Name the method in determination of dissolved oxygen
2. What is the fundamental law of photometers?
3. In a set of data values, the value which appear often is……………
4. What is chromatography?
5. Differentiate the accuracy and precision in analysis
6. What is HPLC?
7. What is the significance of Pearson correlation coefficients in statistical analysis?
8. Name an indicator organism.
9. What are the objectives of sampling?
10. Name the method used for estimation of pesticides present in a solution
11. Ionisation in ICP-AES is due to ………….
12. Errors contributed by analyst is considered as………. errors.

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain the sampling preservation strategies used in environmental sampling
14. Discuss the application of chromatography in desalination
15. Write a note on detectors used in chromatographic techniques
16. Differentiate measures of central tendency and measures of dispersion with examples
17. Explain the working of UV spectrophotometer
18. What is gas chromatography? Explain its importance in various fields.
19. Explain the technique used for estimation of heavy metals in water analysis
20. Explain the principle and procedure of estimation of hardness in a water sample.
21. Explain regression analysis.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Explain the principles, instrumentation and application of flame photometers
23. Explain the instrumentation of HPLC
24. Explain the estimation of organic load in effluent
25. Explain ANOVA with examples

(2x10=20 Marks)

SEMESTER 3

ENV3COR06: ENVIRONMENTAL ENGINEERING

Total Hrs: 54; Credits: 3; Hrs/Week: 3; Total Marks 75(Internal 15 & External 60)

ENV3COR06	**ENVIRONMENTAL ENGINEERING**	L	T	P	C
		3	0	0	3
Objectives	To understand the methods adopted to control environment pollution				
Course Outcome(s):					
CO1	To find out the principles and scope of environmental engineering				
CO2	To recognize various methods adopted in the treatment of waste water in conventional and industrial treatment plants and evaluation of their performance.				
CO3	To understand the instrumental and analytical techniques for air quality monitoring				
CO4	To assess gaseous and particulate pollutants present in the atmosphere both quantitatively and qualitatively.				

Module 1: Introduction to Environmental Engineering (9Hrs)

Introduction to environmental engineering. Principles and scope of environmental engineering. Modern trends in environmental engineering. Water quality monitoring. Water quality requirement and standards for various uses. Quality of water in different sources.

Module 2: Conventional Water Treatment (9Hrs)

Conventional Water Treatment Process: Filtration, Slow and Rapid sand filters - Water Treatment, mixing, flocculation, and coagulation, Jar Test, Aeration, Water softening techniques - Lime Soda process, zeolite process, demineralization. Removal of iron and manganese, Defluoridation of water. Desalination evaporation and distillation. Electro dialysis method, reverse osmosis, freezing process. Flow diagram for conventional sewage treatment.

Module 3: Waste Water Treatment (18Hrs)

Municipal, sewage and industrial Treatment - basic treatment process, water flow rates and their assessment. Unit operation of pre - treatment and primary treatment-screening, comminuting, equalization and sedimentation, Skimming. Secondary treatment - Design concept, biological unit process, nature and kinetics of biological growth, aerobic process, activated sludge process and its modification. Oxidation ponds, oxidation ditch. Attached Growth System - Trickling filters, rotating biological conductors, high rate anaerobic reactor, up flow anaerobic filters. expanded, fluidized bed reactors tertiary/advanced treatment system, filtration, absorption, nitrogen and phosphorous removal, Biological Nutrient Removal (BNR) Systems, Sewage disposal method. Disinfection - chlorination. Characteristics and treatment of typical industrial waste water. Maintenance of effluent treatment plants, Waste water disposal, reuse and recycle.

Module 4: Air Pollution Control (18Hrs)

Sampling equipment, Control of particulate matter - gravitational settling chamber, cyclonic separator, fabric filters, electrostatic precipitators, wet Collectors, Venturi Scrubber.Control of Gaseous Contaminants, adsorption, absorption, and combustion.Air quality monitoring techniques for particulates and gaseous contaminants - Instrumental and analytical techniques for air pollutants - suspended particles, sulphur compounds, hydrogen sulphide, sulphur dioxide, Oxides of nitrogen, carbon monoxide and hydrocarbons.Air pollution from Automobiles-source and control.

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Third Semester

Core Course: Chemistry, Environment and Water Management

ENV 3 COR 06 – ENVIRONMENTAL ENGINEERING

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	9	2	1	1	**4**
2	9	4	4	1	9
3	18	3	2	1	6
4	18	3	2	1	6
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Third Semester

Core Course: Chemistry- Environment and Water Management

ENV3 OR 06 – ENVIRONMENTAL ENGINEERING

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

PART A (Answer any 10 questions)

1. Define BOD.
2. Define Coagulation.
3. Name two water quality standards.
4. Define Bar screen.
5. Define BNR.
6. Define Carbon filter.
7. Name two Primary treatment methods.
8. Define adsorption.
9. Define flocculation.
10. Define chlorination.
11. Define particulate matter.
12. Define Fabric filter.

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain Gravitational settling chamber.
14. Write note on water quality standards.
15. Explain lime soda process.
16. Write note on Desalination.
17. Write note on effects of sulphur dioxide.
18. Explain disinfection.
19. Draw flow diagram for conventional water treatment.
20. Write briefly on secondary waste water treatment.
21. Explain Jar test.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Write Essay conventional water treatment.
23. Write essay on Thermal pollution.
24. Write Brief note on control methods for particulate matter.
25. Write Essay on Water quality monitoring and its importance.

(2x10=20 Marks)

SEMESTER 4

(FUNCTIONAL GROUP CHEMISTRY)

Total Hrs: 54; Credits: 3; Hrs./Wk: 3; Total Marks 75 (Internal 15 & External 60)

CHE4COR04	**ORGANIC CHEMISTRY –II (FUNCTIONAL GROUP CHEMISTRY)**	L	T	P	C
		3	0	0	3
Objectives	To give the students a thorough knowledge about the chemistry of some selected functional groups with a view to develop proper aptitude towards the study of organic compounds and their reactions.				
Course Outcome(s)					
CO1	To learn the chemistry of alcohols, phenols, carboxylic acids, derivatives of carboxylic acids, sulphonic acids, carbonyl compounds, poly nuclear hydrocarbons, active methylene compounds, synthetic reagents and Grignard reagents.				
CO2	To understand and study organic reaction mechanisms.				
CO3	To develop skills required for the qualitative analysis of organic compounds				

Module I: Hydroxy Compounds, Ethers and Organometallics (18 Hrs)

1.1. Hydroxy compounds **(10 Hrs)**

Mono, di and trihydric alcohols- Monohydric alcohols: - Classification, classical methods of preparation of methanol and ethanol, physical properties. Distinction between primary, secondary and tertiary alcohols- Ascend and descend in alcohol series, chemistry of methanol poisoning, harmful effects of ethanol on human body.

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

Trihydric alcohols: Glycerol- synthesis (from fats), reaction with HI, oxalic acids, oxidation.

Phenols: – Acidity of phenols- effects of substituents – comparison of acidity with alcohols. Reaction of phenol with $FeCl_3$, Formation of phenolphthalein and azo dyes. Preparation and uses of nitrophenols, picric acid, catechol, resorcinol and quinol, Mechanisms of Reimer –Tiemann reaction, Lederer- Mannase reaction, Fries Rearrangement.Liebermann's nitroso reaction.

1.2. Ethers and Epoxides **(4 Hrs)**

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

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

1.3. Organometallic compounds **(4 Hrs)**

Grignard reagents-formation, structure and synthetic applications, alkyl lithium, Organo Zinc compounds, Reformatsky reaction.

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

2.1 Aldehydes, Ketones **(14 Hrs)**

Structure and reactivity of the carbonyl group - acidity of alpha hydrogen.Comparative studies of aldehydes and ketones, aliphatic and aromatic aldehydes, formaldehyde and acetaldehyde.Addition and condensation reactions of carbonyl compounds with HCN, ROH, $NaHSO_3$, Grignard reagents and ammonia derivatives.Mechanisms of nucleophilic additions to carbonyl groups - Aldol, Claisen, Claisen-Schmidt, Benzoin, Perkin, Knoevenagel condensations, Cannizzaro's reaction.

Wittig reaction, Mannich reaction (mechanisms needed). Oxidation reactions- Tollen's and Fehling's tests, Iodoform test, Baeyer-Villiger oxidation (mechanism needed). Reduction reactions- Clemmensen, Wolff-Kishner, Meerwein-Ponndorf-Verley reduction, $LiAlH_4$ and $NaBH_4$ reductions (with mechanisms).

2.2 Compounds containing active methylene groups **(4 Hrs)**

thetic uses of malonic ester, acetoacetic ester and cyanoacetic ester. Keto-enol tautomerism.

Module 3: Carboxylic and sulphonic acids and synthetic reagents (18 Hrs)

3.1 Carboxylic and Sulphonic acids **(15 hrs)**

Structure of carboxylate ion- effects of substituents on acid strength of aliphatic carboxylic acids- ascent and descent in fatty acid series, Arndt-Eistert synthesis (Wolff rearrangement to be mentioned), Hell-Volhard- Zelinsky reaction, Kolbe's electrolysis.

Preparation of functional derivatives of carboxylic acids- acid chlorides, esters, anhydrides and amides.Comparative study of the nucleophilicity of acyl derivatives.Methods of formation (any one method) and chemical reactions of anthranilic acid, unsaturated acids (cinnamic acid, acrylic acid), hydroxy acids (malic acid, citric acid), dicarboxylic acids (oxalic acid, malonic acid, adipic acid, maleic acid, fumaric acid).

Preparation, reactions and uses of benzene sulphonic acid, benzene sulphonyl chloride and ortho and para toluene sulphonyl chlorides.

3.2 Synthetic reagents **(3 Hrs)**

tetra acetate, Periodic acid, OsO_4, Selenium dioxide, MCPBA, DCC (elementary idea)

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SEMESTER IV

Core Course: Chemistry (Envt. & Water Management)

CHE4COR04 - ORGANIC CHEMISTRY –II

(Functional Group Chemistry)

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	4	3	1	8
2	18	4	3	2	9
3	18	4	3	1	8
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fourth Semester

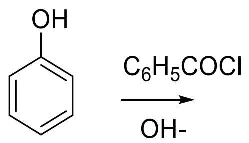
Core Course: Chemistry (Envt. & Water Management)

CHE4COR04 - ORGANIC CHEMISTRY –II

(Functional Group Chemistry)

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

PART A (Answer any 10 questions)

1. Out of phenol and a primary alcohol which is more acidic and why?
2. How will you convert ethanol into methanol?
3. How is Zeisel's method useful in the detection of alkoxy group?
4. $H_2C{=}\underset{H}{C}{-}CHO \xrightarrow{LiAlH_4}$
5. Complete the reaction
6. 
7. What is Kolbe's electrolysis reaction?
8. What is Hofmann's reaction?
9. Name the reagent used in MPV reduction.
10. What is NBS?
11. Write the product obtained when antharanilic acid undergoes decarboxylation
12. Draw the structure of the product obtained when cyclopentanone undergo Baeyer-Villiger oxidation
13. Name the product obtained when aldol undergoes dehydration

i. **(10x1=10 Marks)**

PART B (Answer any 6 questions)

14. What is Reformatsky reaction? Explain with mechanism.
15. Carryout the following conversions.
    (a) Benzaldehyde into Cinnamic acid (b) Glycerol into citric acid.
16. Explain why the chloral hydrate and Ninhydrate although gem-diols are stable
17. Write the method of preparation and explain the basicity of Guanidine.

18. Explain why an electron donating group in Claisen –Schmidt reaction   decreases the rate of reaction whereas electron withdrawing group enhances the rate of reaction
19. Write the mechanism of Arndt-Eistert reaction
20. What is Benzoin condensation? Explain with mechanism.
21. Write the mechanism of pinacol- pinacolone rearrangement
22. Write the method of preparation of picric acid catechol and resorcinol

(6x5=30 Marks)

PART C (Answer any 2 questions)

23. Briefly explain the synthetic utility of compounds containing active methylene groups.
24. Explain the following reactions with mechanism. (a) Claisen rearrangement (b) Perkin condensation.
    (a) Explain briefly the acid and base catalyzed ring opening reactions of ethers.
    (b) Write a note on Crown ethers and applications in organic synthesis.
25. Write equation for the preparation of
    (i) Adipic acid(ii) Malonic acid
    (ii) Malic acid (iv) Maleic acid

(2x10=20 Marks)

SEMESTER 4

ENV4COR07: ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75(Internal 15 & External 60)

ENV4COR07	**ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY**	L	T	P	C
		3	0	0	3
Objectives	To understand the significance of microbes and biotechnological applications in environmental sciences				
Course Outcome(s):					
CO1	To identify the scope of environmental microbiology in our life				
CO2	To find out the benefits and demerits of microorganisms present in air, water and soil				
CO3	To check the infectious diseases caused by microorganisms and to find out the analytical techniques on the qualitative and quantitative estimation of indicator organisms like coli form bacteria.				
CO4	To get an elementary idea about the application of environmental biotechnology on agriculture, energy sector, phytoremediation and bioremediation				

Module 1: Introduction to environmental microbiology (9Hrs)

Scope and history of environmental microbiology -characteristics - classification - identification and morphology of microorganisms, bacteria, archae, fungi, algae, virus and protozoa - growth curve of bacteria- lag phase- exponential phase - stationary phase - and death phase.

Module 2: Microbes and segments of environment (18Hrs)

Earth environment, physico - chemical characteristics of earth environment- soil as microbial environment- biotic stress and abiotic stress – distributionof microorganism in sub surface soil - shallow surface - deep surface. Biogeochemical role of microbes - aero micro biology - microbial survival in air aero microbiological pathway- bio aerosols and its control. Microbial habitat in aquatic environment-plank tonic, benthic microbial mat and biofilm -microbes in fresh water, brackish water, marine water, subterranean water and wet lands.

Module 3: Microbial infectious diseases and indicator microorganism (9Hrs)

Environment and human pathogenic microbes - soil borne, water borne and air borne. Roots of exposure - environmental change and microbial infectious disease. Indicator microorganism, concepts- total coli forms- MPN test, membrane filter technique - other potential indicator species - standards and criteria for indicators.

Module 4: Environmental Biotechnology (18Hrs)

Basic concepts- application in industry- agriculture and energy sectors- bio remediation and phytoremediation. Over view methodology - vermiculture - biofertilizer techniques. Elemental information of gene transfer - cloning - recombinant DNA technology and its implementation. Microbial management of hazards.

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SEMESTER IV

Core Course: Chemistry (Envt. & Water Management)

ENV4COR07: ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	9	3	2	1	6
2	18	4	3	1	8
3	9	2	1	1	4
4	18	3	3	1	7
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fourth Semester

Core Course: Chemistry- Environment and Water Management

ENV4COR07: ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY

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

PART A (Answer any 10 questions)

1. What is bioareosols?
2. Lichen is the pollution indicator of which pollutant
3. What is cloning?
4. What is an indicator organism?
5. What is phytoremediation?
6. What is the lag phase of growth curve of bacteria?
7. What is a biofilm?
8. The organism responsible for tuberculosis
9. Differentiate biotic and abiotic stress
10. What is aero microbiology?
11. Give an application of environmental microbiology in waste management
12. Give an example of gram-negative bacteria.

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain the control measures of bioaerosols
14. Write a note on microbial mat
15. Explain the growth curve of bacteria
16. Explain the application of biotechnology in energy sector
17. Explain the role of microbes in biogeochemical cycles.
18. Explain the morphological and physiological factors in identifying bacteria
19. Explain the role of bioremediation in waste management
20. Explain recombinant technology and its implementation.
21. Explain standards and criteria for indicators

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Explain the scope of environmental microbiology
23. Explain the microbial management of hazards
24. Explain MPN test and membrane filter technique for the estimation of total coli forms in water sample
25. Explain microbial habitat in aquatic environment.

(2x10=20 Marks)

SEMESTER 4

ENV4COR08: ENVIRONMENTAL MANAGEMENT

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75(Internal 15 & External 60)

ENV4COR08	**ENVIRONMENTAL MANAGEMENT**	L	T	P	C
		3	0	0	3
Objectives	To understand the different aspects of environment management				
Course Outcome(s):					
CO1	To identify the significance of Environment impact assessment in a project proposal				
CO2	To understand the environment laws and policies				
CO3	To get an elementary idea on GIS and remote sensing				
CO4	To understand the important components and measures adopted for disaster management.				
CO5	To recognize the methods of solid waste and hazardous waste management.				
CO6	To understand the basic principles of green chemistry.				

Module 1: Environment Impact Assessment (18Hrs)

Introduction: concept, objectives and goals. Origin and development of EIA.Relationship of EIA to sustainable development, EIA in project planning and Implementation - risk assessment and risk management, EIA report. Comparison of alternatives, EIS, EMP, public hearing, review, decision making and monitoring. Methodology of EIA - practices and guidelines in India.EIA case studies. Environmental Planning - principles, concepts and scope of environmental planning - Ecological aspects of EPM - Steps in environmental planning. Scope and types of Environmental audit - audit process - pre and post audit process - objectives and advantages of audit. Ecolabeling - Eco mark, environment management systems ISO 14000 series.

Module 2: Environment Laws and policies (9Hrs)

Sustainable Development: Basic concepts, principles and measures for sustainable development.Brunt land commission report-our common future, Agenda21, National policy statement, National Environment Policy - 2006.International Conventions - Stockholm Declaration, 1972, Ramsar Convention; World Heritage Convention; Kyoto Protocol; Rio Summit (Earth Summit); Johannesburg

Summit,2002.Montreal Protocol.Biodiversity act 2002 and related rules: an overview of application in India. Convenction on International trade of endangered species. National Environmental Movement-Silent valley movement, Chipko movement, Narmada Movement, Appiko movement, Almatti dispute and Tehri dam movement.

Module 3: Remote Sensing and GIS (9Hrs)

History, principle, concept and scope of remote sensing, Electromagnetic energy - Electromagnetic spectrum, Components, principles, stages of remote sensing. Platforms for remote sensing techniques. Sensors - types and resolution. Aerial photography - characteristics of aerial photographs and image interpretation. Satellite imagery- land sat imagery. Basics of GIS.Application of remote sensing and GIS into ground water exploration, mining of mineral resources and wet land conservation.

Module 4: Disaster Management (9Hrs)

Various phases of disaster management- Mitigation, preparedness, response, and recovery. Scope of disaster management/emergency preparedness. Tools of disaster management - Emergency Management Information Systems - organizations related to disaster management. Disasters and Hazard Management: Human and ecological impacts; Risk assessment and Vulnerability analysis; National preparedness and adaptation strategies; Hazards, policies and Agencies; National and International Agencies in disaster management, NDMA, NIDM, State level disaster management authorities

Module 5: Waste Management (9 Hrs)

Solid wastes management- Solid wastes-Types, sources, disposal methods-incineration, and recycling, composting-composting methods-Windrow method. Vermicomposting.Pyrolisis, pulverization, gasification and sanitary landfill.

Hazardous waste management- characteristics of hazardous waste, categorization and its disposal methods.

Green Chemistry - Principles of Green Chemistry, Design of Green Synthesis, prevention of waste and byproducts, Atom Economy, prevention of chemical accidents, microwave assisted green synthesis.

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Fourth Semester

Core Course: Chemistry, Environment and Water Management

ENV4COR08 – ENVIRONMENTAL MANAGEMENT

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	4	2	1	7
2	9	3	2	1	6
3	9	3	1	1	5
4	9	1	1	0	2
5	9	1	3	1	5
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fourth Semester

Core Course: Chemistry, Environment and Water Management

ENV 4 COR 08 – ENVIRONMENTAL MANAGEMENT

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

PART A (Answer any 10 questions)

1. Define EIA.
2. Define Eco labeling.
3. Define Stockholm declaration.
4. Define GIS.
5. Define Chipko movement.
6. Define Aerial photography.
7. Define ISO14000.
8. Define Sensors.
9. Define Environmental Audit.
10. Define NIDM.
11. Define pyrolysis.
12. Define Sustainable development.

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain Green chemistry.
14. Write note on scope of Remotesensing.
15. Explain vermicomposting.
16. Write note on NDMA.
17. Write note on Hazardous waste.
18. Explain Risk assessment.
19. Explain steps of EIA.
20. Write briefly on Silent valley movement.
21. Explain sustainable development and its importance.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Write Essay on EIA and its steps.
23. Write essay on International conventions.
24. Write Brief note on solid waste management.
25. Write Essay on Remote sensing and its applications.

(2x10=20 Marks)

SEMESTERS 3& 4

PRACTICAL: CHE4P02- ORGANIC CHEMISTRY PRACTICAL –I

Total Hrs: 36+36= 72; Credits: 2; Hrs/Week: 2; Total Marks 50 (Internal 10 & External 40)

CHE4P02	**ORGANIC CHEMISTRY PRACTICAL –I**	L	T	P	C
		0	0	2	2
Objectives	To get training for systematic qualitative analysis of simple organic compounds.				
Course Outcome(s)					
CO1	To develop skills required for the qualitative analysis of organic compounds and determination of physical constants				
CO2	To impart the students a thorough knowledge about the chemistry of some selected functional groups and to study the reactions of organic compounds.				

1. Tests for elements: Nitrogen, Halogens and Sulphur (Green technique may also be adopted).
2. Tests for unsaturation
3. Tests for aromatic character.
4. Study of the reactions of the following functional groups: alcohol, phenol, aldehyde, ketone, carboxylic acid, 1,2- dicarboxylic acid, ester, primary, secondary and tertiary amines, amide, nitro and halogen compounds, diamide, anilide, polynuclear hydrocarbons, reducing and non-reducing sugars.
5. Systematic analysis of the following organic compounds containing one functional group and characterization with its physical constant (solid and liquid) and a derivative :- alcohol, phenol, aldehyde, ketone, carboxylic acid, 1,2 dicarboxylic acid, ester, primary,secondary and tertiary amines, amide, nitro and halogen compounds, diamide, anilide, polynuclear hydrocarbons, reducing and non-reducing sugars.

(Minimum 8 compounds to be analyzed, Chemistry of the reaction is necessary)

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2. F.G. Mann and B. C. Saunders, Practical Organic Chemistry, 4thEdn., Pearson Education, 2009.
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SCHEME OF VALUATION
Fourth Semester

Core Course: Chemistry, Environment and Water Management

CHE4P02- ORGANIC CHEMISTRY PRACTICAL –I

1. Analyze the given organic compound qualitatively. Write down the systematic analysis of the given compound with two identification and confirmation tests **[30 Marks]**

Preliminary tests : 1
Detection of Elements : 5
(Sodium fusion extract: 2; Nitrogen detection: 1; Halogen detection: 1; Sulphur detection: 1)
Aromatic/Aliphatic : 1
Saturated/ Unsaturated : 1
Detection of functional group : 8
Confirmation tests (2 Nos) : 8
Systematic recording : 6

2. Find out physical constant of the given organic compound **[2 Marks]**

3. Suggest a suitable derivative of the given compound. Prepare and display the derivative of the given compound **[3 Marks**]

Derivative preparation procedure : 2
Display : 1

4. Viva-voce **[5 Marks]**

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION
Fourth Semester
PROGRAMME: B. SC. CHEMISTRY (Envt. & Water Management)
CHE4P02 - ORGANIC CHEMISTRY PRACTICAL-I

Time: 3 hours **Total Marks: 40**

1. Analyze the given organic compound qualitatively. Write down the systematic analysis of the given compound with two identification and confirmation tests **[30 Marks]**
2. Find out physical constant of the given organic compound **[2 Marks]**
3. Suggest a suitable derivative of the given compound. Prepare and display the derivative of the given compound **[3 Marks]**
4. Viva-voce **[5 Marks]**

SEMESTERS 3& 4

ENV4P02- PHYSICO CHEMICAL ANALYSIS OF SOIL &EFFLUENT I

Total Hrs: 36+36= 72; Credits: 2; Hours/Week: 2; Total Marks 50 (Internal 10& External 40)

ENV4P02	**PHYSICO CHEMICAL ANALYSIS OF SOIL & EFFLUENT I**	L	T	P	C
		0	0	2	2
Objectives	Experimental practice of soil &Effluent analysis To understand properties of soil &effluents and its and analytical techniques				
Course Outcome(s):					
CO1	To identify the physical and chemical characteristics of soil and effluent				
CO2	To perform the analysis of some parameters determining the chemical properties and fertility of the soil.				
CO3	To analyze the presence and amount of some nutrients in the effluent				
CO4	To get an elementary idea on working principle of some instruments.				

General Instructions

1. Use safety coat, goggles, shoes and gloves in the laboratory.
2. For weighing electronic balance may be used.
3. Titrations are used for volumetric analysis.
4. Colorimeters and spectrophotometers are used for colorimetric analysis.
5. A total of 5 experiments must be done from module I and 3 instruments from module II to appear for the examination.
6. Practical examination will be conducted at the end of semester IV.

Module I: Analysis

1. Determination of moisture content in soil sample
2. Determination of water holding capacity of soil
3. Determination of pH of soil sample
4. Determination of total organic carbon in soil sample
5. Determination of nitrite-nitrogen in effluent sample
6. Determination of nitrite-nitrogen in soil sample
7. Determination of BOD in effluent sample
8. Analysis of sodium and potassium in water and soil sample

Module II: Instrumentation

1. High volume air sampler
2. Flame photometer
3. High performance liquid chromatograph

REFERENCES

1. Grasshoff. K., Ehrhardt. M., and Kremling. K., (1999). Methods of Seawater
2. Analysis. 3rdEdn. Wiley – VCH.[2].
3. APHA (2012). Standard methods for the Examination of water and waste water. n2ndEdn.[3].
4. IOC Manuals and Guides – 12. (1983). Chemical methods for use in Environmental
5. Monitoring. UNESCO.[4].
6. APHA. (1985). Standard methods for examination water and waste water. American public Health association. New York.[5].
7. Tomer, M., (1999). Quality Assessment of water and waste water.CRC press.USA.[6].
8. Pansu, M. and Gautheru. J., (2006). Handbook of Soil Analysis - Mineralogical,
9. organic and inorganic methods. Springer Berlin Heidenberg, Netherlands.[7].
10. Padnayik. P., (1997). Hand book of Environmental Analysis - Chemical pollutant in Air, water, soil and solid waste. CRC press, USA.[8].
11. Jones, J.B, Jr., (2001). Laboratory guide for conducting soil tests and plant analysis. CRC Press, USA.

SCHEME OF VALUATION
Fourth Semester

Core Course: Chemistry, Environment and Water Management

ENV4P02- PHYSICO CHEMICAL ANALYSIS OF SOIL &EFFLUENT I

No	Experiments	Marks division	Marks
1	Minor experiment module I	Principle -1 Procedure -1 Accuracy up to 3%- 6 marks. Deduct one mark for each 0.1% above 3.5% 2 marks Observation &Result -2	10
2	Major experiment module I	Principle -1 Procedure -1 Accuracy up to 2 % 16 marks. Deduct one mark for each 0.1 % above 3% 6 marks Observation &Result -2	20
3	Instrument module II	Working principle - 3 Diagram- 2	5
4	Viva voce module I&II	5	5

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION
Fourth Semester
PROGRAMME: B. SC. CHEMISTRY (Envt. & Water Management)
ENV4P02- PHYSICO CHEMICAL ANALYSIS OF SOIL &EFFLUENT I

Time: 3 Hrs. **Total Marks: 40**

1. Estimate the PH of given Soil sample (minor experiment) **(10 Marks)**
2. Estimate total organic cabon in given soil sample (major experiment) **(20 Marks)**
3. Explain the working principle of any of the instruments **(5 Marks)**
   a) High volume air sampler
   b) Flame photometer
4. Viva voce **(5 Marks)**

SEMESTERS 3& 4

ENV4P03- PHYSICO CHEMICAL ANALYSIS OF SOIL &EFFLUENT II

Total Hrs: 36+36= 72; Credits: 2; Hrs/Wk: 2; Total Marks 50 (Internal 10& External 40)

<table>
<tr><td rowspan="2">ENV4P03</td><td rowspan="2">PHYSICO CHEMICAL ANALYSIS OF SOIL & EFFLUENT II</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Objectives</td><td colspan="5">Experimental practice of soil &Effluent analysis
To understand properties of soil &effluents and its and analytical techniques</td></tr>
<tr><td colspan="6">Course Outcome(s):</td></tr>
<tr><td>CO1</td><td colspan="5">To identify the physical and chemical characteristics of soil and effluent</td></tr>
<tr><td>CO2</td><td colspan="5">To perform the analysis of some parameters determining the chemical properties and fertility of the soil.</td></tr>
<tr><td>CO3</td><td colspan="5">To analyze the presence and amount of some nutrients in the effluent</td></tr>
<tr><td>CO4</td><td colspan="5">To get an elementary idea on working principle of some instruments.</td></tr>
</table>

General Instructions

1. Use safety coat, goggles, shoes and gloves in the laboratory.
2. For weighing electronic balance may be used.
3. Titrations are used for volumetric analysis.
4. Colorimeters and spectrophotometers are used for colorimetric analysis.
5. A total of 5 experiments must be done from module I and 3 instruments from module II to appear for the examination.
6. Practical examination will be conducted at the end of semester II.

Module I Analysis

1. Determination of Electrical conductivity of soil sample
2. Determination of carbonates and bicarbonates in soil sample
3. Determination of chloride in soil sample
4. Determination of phosphate- phosphorous in effluent sample
5. Determination of phosphate- phosphorous in soil sample
6. Determination of iron in water sample.
7. Determination of COD in effluent sample.

Module II Instrumentation

1. Atomic absorption spectroscope
2. Gas liquid chromatograph
3. Inductively – coupled plasma emission spectroscope

References

[1]. Grasshoff. K., Ehrhardt. M., and Kremling. K., (1999). Methods of Seawater Analysis. 3rdEdn. Wiley – VCH.

[2]. APHA (2012). Standard methods for the Examination of water and waste water. 2ndEdn.

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[7]. Padnayik. P., (1997). Hand book of Environmental Analysis - Chemical pollutants in Air, water, soil and solid waste. CRC press, USA.

[8]. Jones, J.B, Jr., (2001). Laboratory guide for conducting soil tests and plant analysis. CRC press, USA.

SCHEME OF VALUATION
Fourth Semester

Core Course: Chemistry, Environment and Water Management

ENV4P03- PHYSICO CHEMICAL ANALYSIS OF SOIL & EFFLUENT II

Question no.	Experiments	Marks division	Marks
1	Minor experiment module I	Principle -1 Procedure -1 Accuracy up to 3%- 6 marks. Deduct one mark for each 0.2% above 3.5% 2 marks Observation &Result -2	10
2	Major experiment module I	Principle -1 Procedure -1 Accuracy up to 2 % 16 marks. Deduct one mark for each 0.1 % above 3% 6 marks Observation &Result -2	20
3	Instrument module II	Working principle - 3 Diagram- 2	5
4	Viva voce module I&II	5	5

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION
Fourth Semester
PROGRAMME: B. SC. CHEMISTRY (Envt. & Water Management)
ENV4P03- PHYSICO CHEMICAL ANALYSIS OF SOIL & EFFLUENT II

Time: 3 Hrs. **Total Marks: 40**

1. Estimate the chloride content in given Soil sample (minor experiment) **(10 Marks)**
2. Estimate carbonates and bicarbonates in given soil sample (major experiment) **(20 Marks)**
3. Explain the working principle of any of the instruments **(5 Marks)**
   a) AAS
   b) GLC
4. Viva voce **(5 Marks)**

SEMESTER 5

CHE5COR05 - ENVIRONMENTAL STUDIES AND HUMAN RIGHTS

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

CHE5COR05	**ENVIRONMENTAL STUDIES AND HUMAN RIGHTS**	L	T	P	C
		3	0	0	3
Objectives	To understand the fragile and sensitive nature of environment, and to realize the importance of its protection,				
Course Outcome(s)					
CO1	To develop an awareness of scope, resources and problems related to environment				
CO2	To understand the legal solutions and awareness of environmental social issues				
CO3	To get an understanding about different types environmental pollutions				
CO4	To understand the basic ideas of toxicology and green chemistry				
CO5	To study nuclear model and nuclear reactions				
CO6	To acquire an awareness of human rights				

Unit 1: Multidisciplinary Nature of Environmental Studies (10 Hrs)

Definition, scope and importance. Need for public awareness. Natural resources: Renewable and non-renewable resources, forest resources - use and over-exploitation, deforestation.

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

Unit 2: Ecosystems **(6 Hrs)**

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

Unit 3: Social Issues and the Environment (**5 Hrs**)

Urban problems related to energy. Water conservation, rain water harvesting, water shed management. Resettlement and rehabilitation of people: its problems and concerns.

Environmental ethics: Issues and possible solutions. Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act,Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

Unit 4:. Air, Water and Soil Pollution **(8 Hrs)**

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

Water pollution**:** Causes- organic, inorganic and macroscopic contaminants, effects of pesticides, insecticides and detergents on water pollution. Marine pollution, eutrophication, biomagnification, water quality parameters-DO, BOD, COD.

Soil pollution: Causes and effects: Agrochemicals, industrial wastes, petroleum wastes, electronic wastes, landfill and dumping. Genetically modified plants.

Unit 5: Toxicology and Toxicological Effects **(3 Hrs)**

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

Unit 6: Introduction to Green Chemistry **(3 Hrs)**

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

Unit 7: Environmental Aspects of Nuclear Chemistry **(8 Hrs)**

Nuclear particles, size of the nucleus - nuclear forces - nuclear stability – N/P ratio – packingfraction – mass defect – binding energy - magic numbers. Nuclear models – shell model andliquid drop model.

Natural radioactivity. Modes of decay- group displacement law — rate of decay – decay constant – half-life period – Gieger-Nuttall rule – disintegration series – transmutation reactions using protons, deutrons, _-particles and neutrons. Artificial radioactivity – positron emission and K electron capture – Transuranic elements, spallation reactions.

Applications of radioactivity: Radio carbon dating – rock dating – isotopes as tracers – study of reaction mechanism (ester hydrolysis). Application of radioactive isotopes in medicine.

Nuclear fission - atom bomb - nuclear reactors – fast breeder reactors. Nuclear fusion and hydrogen bomb. Nuclear waste and its impact on environment – nuclear waste management

Unit 8: Introduction to Human Rights (11 Hrs)

An Introduction to Human Rights, meaning, concept and development. Three generations of human rights (civil and political rights; economic, social and cultural rights).Human Rights and United Nations – contributions, main human rights related organs - UNESCO,UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights. Human Rights in India: Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities. Environment and Human Rights - right to clean environment and public safety.Issues of industrial pollution, prevention, rehabilitation and safety aspect of new technologies such as chemical and nuclear technologies, issues of waste disposal, protection of environment.

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6. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)
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9. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
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11. Rao.M.N & Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p (Ref)
12. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
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15. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media (Ref)
16. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref)
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19. S. Glasstone, Source Book on Atomic Energy, 3rd Edition, East-West Press Pvt. Ltd., New Delhi, 1967.
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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5COR05 - ENVIRONMENTAL STUDIES AND HUMAN RIGHTS

Module	Hrs Alloted	Part A 2 MarkS 10/12	Part B 5 Marks 6/9	Part C 15 Marks 2/4	Total questions
1	10	2	2	1	5
2	6	1	1		2
3	5	1	1		2
4	8	1		1	2
5	3	1	1		2
6	3	1			1
7	8	2	2		4
8	11	3	2	2	7
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fifth Semester

Core Course: Chemistry

CHE5COR05 - ENVIRONMENTAL STUDIES AND HUMAN RIGHTS

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

PART A (Answer any 10 questions)

1. Define soil erosion.
2. Give two examples for metallic minerals.
3. Give example of a food chain.
4. Discuss any one method for rain water harvesting.
5. What is global warming?
6. What is Minamata disease?
7. Explain the concept of atom economy.
8. What is the significance of N/P ratio?
9. What is Gieger- Nuttall rule?
10. Define human rights. Discuss the various stages of its development.
11. Write a short note on right to information.
12. Evaluate the Marxian approach to the study of human rights.

i. (10x2=20 Marks)

PART B (Answer any 6 questions)

13. Write notes on renewable and nonrenewable natural resources.
14. Explain the problems associated with over-utilization of surface and ground water.
15. Discuss the structure and function of a forest ecosystem.
16. What do you mean by resettlement and rehabilitation of people? Describe its causes and problems.
17. Discuss the impact of toxic chemicals on enzymes.
18. Discuss the impact of nuclear wastes on environment.
19. Write notes on different nuclear models.
20. Give a brief description on Habeas Corpus.
21. Write notes on fundamental rights.

22. (6x5=30 Marks)

PART C (Answer any 2 questions)

22. Discuss the effects of modern agricultural practices and fertilizer pesticide problem on food resources.
23. a. Discuss briefly the water quality parameters.
    b. Write a note on (i) eutrophication and (ii) biomagnification.
24. a. Explain the relationship between science, technology and human rights.
    b. Write notes on women empowerment. What are the steps takenby the government for the women empowerment?
25. a. Examine the civil liberties mentioned in the constitution of India.
    b. Discuss the role of UN in the coordination of human rights.

(2x15=30 Marks)

SEMESTER 5

CHE5COR06- ORGANIC CHEMISTRY-III

(NATURAL PRODUCTS)

Total Hrs: 54; Credits: 3; Hrs/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE5COR06	**ORGANIC CHEMISTRY-III (NATURAL PRODUCTS)**	L 3	T 0	P 0	C 3
Objectives	To enable the students to gain a detailed knowledge of the chemistry of different natural products and biomolecules.				
Course Outcome(s)					
CO1	To understand the basic structure and properties of carbohydrates.				
CO2	To understand the basic structure and classification of terpenoids, steroids, alkaloids, vitamins and lipids.				
CO3	To understand the basic structure and bonding in amino acids, proteins and green fluorescent proteins.				
CO4	To understand the basic components, biological functions and importance of nucleic acids.				
CO5	To understand the chemical nature, classification and mechanism of action of enzymes.				

Module 1: Natural products - I (Carbohydrates) (18 Hrs)

1.1 Monosaccharides: classification - constitution of glucose and fructose. Reactions of glucose and fructose - osazone formation. Mutarotation and its mechanism. Cyclic structure-Pyranose and furanose forms. Determination of ring size. Haworth projection formula, configuration of monosaccharides, epimerisation, chain lengthening and chain shortening of aldoses. Inter conversion of aldoses and ketoses.

1.2 Disaccharides: Structure of sucrose and maltose. Ring structure. Reactions of sucrose.

1.3 Polysaccharides: Structure and properties of starch and cellulose. (Elementary idea). Industrial applications of cellulose.

Module 2: Natural products –II (Terpenoids, steroids, alkaloids, vitamins and lipids) (18 Hrs)

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

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

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

2.4 Vitamins: Classification-structure (elucidation not required) and deficiency diseases of vitamin A, C, B_1, B_2, B_6.

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

Module 3: Natural Products –III (Amino acids, proteins, nucleic acids and enzymes)

(18 Hrs)

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

3.2 Proteins: Classification of proteins based on physical and chemical properties and on physiological functions. Structure of proteins, helical and sheet structures (elementary treatment only). Denaturation of proteins.

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

3.4 Green Fluorescent Proteins (elementary idea).

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

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Further reading

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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5COR06- ORGANIC CHEMISTRY-III

(NATURAL PRODUCTS)

Module	Hours Allotted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	4	3	1	8
2	18	4	3	1	8
3	18	4	3	1	8
				25. a)- from Module 1 (4 marks) b) from Module 2 (3 marks) c) Module 3 (3 marks)	1
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fifth Semester

Core Course: Chemistry

CHE5COR06- ORGANIC CHEMISTRY-III

(NATURAL PRODUCTS)

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

PART A (Answer any 10 questions)

1. Give two examples of reducing sugars.
2. Which reaction indicates fructose contains five hydroxyl groups?
3. What is celluloid?
4. What are the monomers of maltose?
5. Draw the structure of Vitamin C.
6. What is isoprene rule?
7. Draw the structure of cholesterol.
8. Which are the products obtained when nicotine is oxidized with alkaline $KMnO_4$?
9. Give two examples of acidic amino acids.
10. Draw the zwitter ionic form of alanine.
11. What do you mean by denaturation of proteins?
12. What are the purine bases present in DNA and RNA?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Draw the pyranose and furanose forms of α and β forms of glucose and fructose
14. How will you convert
    a. Fructose to glucose
    b. Glucose to fructose.
15. What is Kiliani synthesis? Give an example.
16. Define saponification value and iodine value of oil? What is their significance?
17. Briefly explain HDL and LDL with their functions.
18. Illustrate the structural elucidation of citral.
19. Write notes on green fluorescent proteins.
20. What are the different types of enzyme inhibition? Explain with examples.
21. Describe solution phase peptide synthesis.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Discuss the industrial applications of cellulose.
23. Discuss the biosynthesis of cholesterol.
24. Discuss the structure of proteins.
25. a). Give the structure and two reactions of sucrose with equations. (4 marks)

    b). Illustrate the synthesis of nicotine. (4 marks)

    c). Explain the Strecker amino acid synthesis. (4 marks)

(2x10=20 Marks)

SEMESTER 5

CHE5COR07 – PHYSICAL CHEMISTRY- I

(STATES OF MATTER AND SURFACE CHEMISTRY)

Total Hours: 36; Credits: 2; Hours/Week: 2; Total Marks 75 (Internal 15 & External 60)

CHE5COR07	PHYSICAL CHEMISTRY- I (STATES OF MATTER AND SURFACE CHEMISTRY)	L	T	P	C
		3	0	0	3
Objectives	To understand the general characteristics of different states of matter				
Course Outcome(s)					
CO1	To understand the nature and properties of fluids				
CO2	To study the intermolecular forces in gases and liquids				
CO3	To understand the dynamics of the molecules in the gases and liquids				
CO4	To study liquefaction of gases				
CO5	To acquire the ability to view 3-dimensional geometry of solids				
CO6	To understand the symmetry of crystals				
CO7	To study defects in crystals				
CO8	To acquire the ability to connect the theories of adsorption with nature.				
CO9	To understand the nanoscience through colloids.				

Module 1: Gases (12 Hrs)

Kinetic molecular model of gases: pressure of an ideal gas, derivation of gas laws, Maxwell's distribution of velocities – molecular velocities (average, root mean square and most probable velocities- no derivation). Collision diameter, mean free path, viscosity of gases – temperature and pressure dependence. Relation between mean free path and coefficient of viscosity (no derivation). Barometric distribution law, Law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Real gases: compressibility factor Z, van der Waals equation of state – derivation and application in explaining real gas behaviour. Virial equation of state, van der Waals equation expressed in virial form – calculation of Boyle temperature, Isotherms of real gases, continuity of states. Critical phenomena. Liquefaction of gases (based on Joule-Thomson effect)

Module 2: Liquids **(3Hrs)**

Intermolecular forces in liquids (qualitative idea only)- viscosity, determination of viscosity- the viscometer method – surfacetension – surface energy, refractive index, physical properties and chemical constitution of liquids. Unusual behaviour of water.

Module 3: Solid state **(15 Hrs)**

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

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

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

Module 4: Surface chemistry **(6Hrs)**

Adsorption – types, adsorption of gases by solids – factors influencing adsorption – Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation). The BET theory (no derivation) – use of BET equation for the determination of surface area. Colloids- classification, properties- optical and electrical, coagulation, electrical properties- electrophoresis and electrosmosis. Stability of colloids, origin of charge on colloidal particles, electrical double layer, zeta potential.

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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5COR07 – PHYSICAL CHEMISTRY- I

(STATES OF MATTER AND SURFACE CHEMISTRY)

Module	**Hrs Alloted**	**Part A 1 Mark 10/12**	**Part B 5 Marks 6/9**	**Part C 10 Marks 2/4**	**Total questions**
1	12	3	3	1.5	7.5
2	3	2	1	0	3
3	15	5	4	1.5	10.5
4	6	2	1	1	4
					25

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION
Fifth Semester
Core Course: Chemistry
CHE5COR07 – PHYSICAL CHEMISTRY- I
(STATES OF MATTER AND SURFACE CHEMISTRY)

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

PART A (Answer any 10 questions)

1. The average distance travelled by a molecule between two successive collisions is called ………………..
2. The compressibility factor (Z) for an ideal gas is………
3. Which among the following gases has the highest RMS velocity at a given temperature. Why?
4. H_2 (b) O_2 (c) He (d) Cl_2
5. What is the effect of temperature on the viscosity of a liquid
6. High boiling point of water is due to………………..
7. Mention the crystal system which has maximum number of Bravais lattices. Find the number of atoms present in a unit cell of a monoatomic substance of a face centred cubic crystal system
8. What is the number of tetrahedral voids in a closed packed array of N spheres
9. Define superconductivity and mention the scientist who discovered it?
10. Find out the Miller indices of a plane making the intercepts of 2a, 3b and 2c
11. Give one example each for positively charged colloid and negatively charged colloid
12. State Hardy-Schulze rule. **(10x1=10 Marks)**

PART B (Answer any 6 questions)

13. Calculate the RMS, average and most probable velocity of O_2 gas at 27 °C
14. Explain the role of Joule Thomson effect in the liquefaction of gases using anyone liquefaction process
15. Derive the Bragg equation and state the terms involved
16. Using the van der Waals constants, calculate the critical constants: V_c, P_c and T_c for CO_2 molecule. (a= 3.6 atm L^2 mol^{-2} ; b= 0.0427 L mol^{-1}; R= 0.0821 L atm K^{-1} mol^{-1}).
17. Discuss the conduction mechanism of n-type and p-type semiconductors
18. Explain the various types of three dimensional close packing of spheres
19. Briefly describe the classification of liquid crystals
20. Discuss the electrokinetic phenomena exhibited by colloids
21. Give an account of various types of intermolecular forces.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. (a) Briefly explain the powder method for the X-ray diffraction studies of crystals

    (b) Explain the significance of Maxwell's equation and the effect of temperature on the distribution of molecular velocities

23. (a) Derive Langmuir adsorption isotherm and explain how it is useful in the determination of the surface area of the adsorbent

    (b) Explain the terms electrical double layer and Zeta potential associated with colloids

24. Derive the van der Waals equation of state and illustrate how this equation satisfactorily explains the departure of real gases from Ideal behaviour

25. (a) Discuss the Zinc blende and Wurtzite structures

    (b) Briefly explain intrinsic defects in crystals

(2x10=20 Marks)

SEMESTER 5

CHE5COR08PHYSICAL CHEMISTRY -II

(QUANTUM MECHANICS, SPECTROSCOPY AND PHOTOCHEMISTRY)

Total Hrs: 54; Credits: 3; Hrs/Week: 2; Total Marks 75 (Internal 15 & External 60)

CHE5COR08	**PHYSICAL CHEMISTRY -II (QUANTUM MECHANICS, SPECTROSCOPY AND PHOTOCHEMISTRY)**	L	T	P	C
		3	0	0	3
Objectives	To understand the fundamentals of quantum mechanics and its applications, molecular spectroscopy and photochemistry.				
Course Outcome(s)					
CO1	To differentiate between classical and quantum mechanics				
CO2	To get aware about the postulates of quantum mechanics and the quantum mechanical model of the hydrogen atom				
CO3	To apply VBT and MOT to explain bonding in molecules.				
CO4	To know the principle and applications of microwave, infrared, Raman, electronic and magnetic resonance spectroscopy.				
CO5	To study the fundamentals of mass spectrometry				
CO6	Toapply the fundamentals of photochemistry in daily life situations.				
CO7	To develop numerical ability and problem solving skill.				

Module 1: Quantum mechanics **(18Hrs)**

Classical mechanics: concepts, failure of classical mechanics, qualitative idea about the energy distribution in black body radiation. Plank's radiation law, Compton Effect.

Binding energy of an electron in hydrogen atom, radius of the hydrogen atom, de Broglie hypothesis, dual nature of electrons – Davisson and Germer's experiment. Heisensberg's uncertainty principle and its significance. Sinusoidal wave equation (no derivation needed). Wave function – physical interpretation, concept of operators, eigen functions, eigen values.

Postulates of quantum mechanics, Particle in one-dimensional box – derivation for energy, application to linear conjugated polyene (butadiene). Introductory treatment of Schrödinger equation for hydrogen atom. Quantum numbers and their importance, hydrogen like wave functions – radial and angular wave functions, radial distribution curves.

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

Module 2: Molecular spectroscopy- I (18Hrs)

Molecular Symmetry - symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, proper and improper axes of symmetry, combination of symmetry elements, molecular point groups, Schoenflies symbol.

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

Rotational spectrum (microwave spectroscopy): diatomic molecules, energy levels of a rigid rotator, selection rules, nature of rotational spectrum, determination of bond length.

Vibrational spectrum (IR spectroscopy): the simple harmonic oscillator – energy levels, force constant, selection rules, nature of vibrational spectrum. Anharmonic oscillator – pure vibrational spectra of diatomic molecules, selection rules, fundamental frequencies, overtones, hot bands. Degrees of freedom for polyatomic molecules, concept of group frequencies – frequencies of common functional groups in organic compounds.

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

Module 3: Molecular spectroscopy - II (15 Hrs)

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

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

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

Module 4: Photochemistry (3 Hrs)

Interaction of radiation with matter: Laws of photochemistry – Grothus-Draper law, Stark-Einstein law, examples of photochemical reactions. Beer law and Beer-Lambert's law. Jablonsky diagram, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Quantum yield, primary and secondary processes. Basic concepts of photosensitized reactions – photosynthesis, dissociation of hydrogen molecule, isomerization of 2-butene, and chemiluminescence.

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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5COR08- PHYSICAL CHEMISTRY -II

(QUANTUM MECHANICS, SPECTROSCOPY AND PHOTOCHEMISTRY)

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	3	3	1 + 1/2	7+1/2
2	18	3	3	1 + 1/2	7+1/2
3	15	5	2	1	8
4	3	1	11`	0	2
		12	9	4	**25**

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fifth Semester

Core Course: Chemistry

CHE5COR08- PHYSICAL CHEMISTRY -II

(QUANTUM MECHANICS, SPECTROSCOPY AND PHOTOCHEMISTRY)

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

PART A (Answer any 10 questions)

1. What is meant by a well-behaved wave function?
2. Determine the angular momentum of electron in 4d orbital.
3. Write down Schrodinger wave equation in 3 dimensions.
4. State Beer Lamberts law.
5. Give a molecule belongs to C_{2v} point group.
6. What is Fermi resonance?
7. Draw the proton NMR spectrum of ethanol.
8. What is Larmor precision?
9. State Frank Condon principle.
10. Write the principle behind mass spectroscopy.
11. Differentiate chromophore and auxochrome.
12. Give two examples for photosensitized reactions.

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain Davisson and Germer experiment.
14. Discuss the postulates of Quantum mechanics.
15. Calculate the de- Broglie wavelength of an electron (mass of the electron=9.11 x 10^{-31} Kg) moving at 1% speed of light.
16. Discuss on the no:of vibrational modes and IR peaks of CO_2 molecule. State mutual exclusion principle.
17. Force constant of CO is 1840 cm^{-1}. Calculate the vibrational frequency in cm^{-1}.
18. Derive the expression for bond length of a diatomic molecule using microwave spectroscopy.
19. Explain the terms a) chemical shift b) Sheilding and de shielding effect.
20. Why TMS is reference in NMR spectroscopy. Predict the nmr signals of a) acetaldehyde b) Toluene

21. Explain fluorescence and phosphorescence using Jablonsky diagram.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. a) Compare MOT and VBT

    b) Discuss the physical significance of wave function.

23. a) Derive the expression for energy for a particle in 1 D box.

    b) Discuss briefly the basic principles and quantum theory of Raman effect.

24. a) Explain fundamental band, overtones and hot bands.

    b) The rotational spectrum of $^{79}Br^{19}F$shows a series of successive lines separated by 0.71433 cm^{-1}. Calculate B, moment of inertia and inter nuclear distance.

25. a) Explain the principles of mass spectroscopy. How this technique is used in molecular mass determination.

    b) Explain the terms bathochromic shift, hyperchromic shift, hypochromic shift and hypsochromic shift.

(2x10=20 Marks)

SEMESTER 5

CHOICE BASED COURSE–I

(Anyonecoursetobeoptedfromthefollowingcourses)

CHE5CBP01: CHEMISTRY IN EVERYDAY LIFE

Total Hours: 72; Credits: 4; Hours/Week: 4; Total Marks 100 (Internal 20 & External 80)

CHE5CBP01	CHEMISTRY IN EVERYDAY LIFE	L	T	P	C
		4	0	0	4
Objectives	To learn chemistry as an integral part of everyday life				
Course Outcome(s)					
CO1	Tostudythegeneralinformationaboutthefoodweeat, theclothswe wear, the drugs we take, thecosmeticsweapply andthe house hold cleaning materials				
CO2	Tolearn aboutthepros and cons ofusingprocessed foodstuff,whichis in voguetoday				
CO3	To become aware of the proper management of the plastics, pesticides, fertilizers and solid wastes				

Module1:Food additives (18Hrs)

1.1. Food additives-definition. Preservatives, food colours-permitted and non-permitted, toxicology.Flavours-natural and synthetic. Artificial sweeteners, emulsifying agents, antioxidants, Leavening agents and flavour enhancers.Importance of food additives, toxicology of food additives.Soft drinks-formulation and health effects. Health drinks. Fast foods and junk foods and their health effects.

1.2. Adulteration, Adulterants in milk, ghee, oil, coffee powder, tea, asafoetida, chilli powder, pulses and turmeric powder - identification. Food spoilage: Risk factors associated with food born illness. Spoilage of milk, canned food, fruits and vegetables. Food laws and standards. Food safety and Standards act 2006. Voluntary standards and certification system.

1.3. Measurement of Energy Value of food, Calorific value, calorie requirement, Kilocalorie. Basal metabolic rate (BMR):- Significance, Condition, factors, measurement.

Module2:Household Materials **(18Hrs)**

2.4 Soaps: Introduction, detergent action of soap, toilet soap, bathing bars, washing soaps, liquid soap manufacture-additives, fillers and flavours.TFM and grades of soap.

2.5 Detergents:- Introduction, detergent action, types of detergents-cationic, anionic, amphiphilic detergents. Common detergent additives. Enzymatic detergents. Biodegradable and non-biodegradable detergent. Environmental hazards. Comparison between soaps and detergents.

2.6 Cosmetics:- Introduction, classification–bathing oils, face creams, skin products, perfumes, dental cosmetics, hair dyes, shaving cream, shampoo, talcum powder, toothpaste, deodorants, lipstick–ingredients. General formulation of each type. Harmful chemicals in cosmetics. Toxicology of cosmetics.

Module3: Plastics, Paper and Dyes **(9Hrs)**

3.4Plastics in every day life. Brief idea of polymerization– Thermoplastic and thermosetting polymers. Use of PET, HDPE, PVC, LDPE, PP, ABS. Reuse, reduce and recycle of plastics. Biodegradable plastics. Environmental hazards of plastics.

3.5Newsprint paper, writing paper, paperboards, cardboards. Organic materials, wood, cotton, jute and coir. International recycling codes and symbols for identification.

3.6Natural and synthetic dyes(basic idea only).

Module4: Drugs **(9Hrs)**

4.2 Chemotherapy:-Drugs and their classification, Drug-target interactions. Enzymes as drug targets, Receptors as drug targets. Therapeutic action of different classes of drugs-analgesics, antipyretics, antihistamines, antacids, antibiotics, antifertility drugs, psychotropic drugs - tranquilizers, antidepressants and stimulants. Antiseptics and disinfectants.

Module5: Chemistry and Agriculture **(12Hrs)**

5.3 Fertilizers: natural, synthetic, mixed fertilizers. NPK fertilizers. Excessive use of fertilizers and its impact on the environment. Biofertilizers–types. Nitrogen fixation-symbiotics and nonsymbiotics using mycorrhiza. Plant growth hormones.

5.4 Pesticides:-Classification-insecticides, herbicides, fungicides. Excessive use of pesticides–environmental hazards. Bio pesticides.

Module 6: Integrated Solid Waste Management **(6Hrs)**

Objectives of solid waste management, types and sources of solid wastes, solid waste disposal methods –incineration, pulverization, pyrolysis, composting-vermi and windrow composting, biogas production. Landfilling- sanitary and secure. Hazardous waste management. Recycling of solid wastes. E-waste management.

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SEMESTER V

PROGRAMME: B.Sc. CHEMISTRY

CHE5CBP01:CHEMISTRY IN EVERYDAY LIFE

Module	Hrs Alloted	Part A 2 Marks 10/12	Part B 5 Marks 6/9	Part C 15 Marks 2/4	Total questions
1	18	1	2	1	4
2	18	2	2		4
3	9	2	2	1	5
4	9	2	1	1	4
5	12	3	2		5
6	6	2	0	1	3
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Fifth Semester

Core Course:Chemistry

CHE5CBP01:CHEMISTRY IN EVERYDAY LIFE

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

PART A (Answer any 10 questions)

1. What is a biopesticide? Give examples?
2. Differentiate toilet soap and bathing bars.
3. What do you mean by NPK fertilizer?
4. What is BMR? What is its significance?
5. What is a tranquilizer? Give examples?
6. What is enzymatic detergent?
7. Explain the mode of antibacterial action of penicillin.
8. What are the objectives of solid waste management?
9. What is a dye? How it is classified?
10. What is eutrophication?
11. What is biopol? Give its one application.
12. Recycling is the integral part of solid waste management. Comment.

(10x2=20 Marks)

PART B (Answer any 6 questions)

13. Explain four food safety acts in India
14. Discuss voluntary standards and certification system in India
15. Write a note on recycling codes of Plastics.
16. Explain the benefits of using biofertlizers.
17. Write a note on toxicology of cosmetics.
18. Distinguish between deodorants and antiperspirants.
19. Is emergency contraceptive pill is a medical abortion pill. Why?
20. Explain Drug-target interaction.
21. Write a note on plant growth hormone.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. What are food additives? Explain different types of additives with examples.
23. What is chemotherapy? Explain the classification of chemicals used in chemotherapy according to their mode of action?
24. Discuss various methods of solid waste disposal.
25. Discuss the toxicity and environmental hazards of pesticides

(2x15=30 Marks)

SEMESTER 5

CHE5CBP02: FOOD SCIENCE

Total Hours: 72; Credits: 4; Hours/Week: 4; Total Marks 100 (Internal 20 & External 80)

CHE5CBP02	**FOOD SCIENCE**	L	T	P	C
		4	0	0	4
Objectives	To get a basic understanding of the different aspects of food science				
Course Outcome(s)					
CO1	To understand the chemistry of food adulteration and adulterants				
CO2	To know the methods of analyzing the adulterants				
CO3	To know the chemistry of food poisoning				
CO4	To acquire knowledge about food additives				
CO5	To understand the chemistry of beverages and soft drinks				
CO6	To know the methods of preparing the soft drinks by field visits				
CO7	To acquire knowledge about various edible oils and the processing techniques related to oils				

Module 1: Food Adulteration (18 Hrs)

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

Module 2: Food Poisons (9 Hrs)

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

Module 3: Food Additives (18 Hrs)

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

Module 4: Beverages (9 Hrs)

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

Module 5: Edible Oils **(18 Hrs)**

Fats, oils - Sources of oils - Production of refined vegetable oils - Preservation. Saturated and unsaturated fatty acids – Iodine value - Role of MUFA and PUFA in preventing heart diseases - determination of iodine - value, RM value, saponification value and their significance. Estimation of I_2 and RM values in Edible oils

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SEMESTER 5

CHE5CBP03: FORENSIC SCIENCE

Total Hours: 72; Credits: 4; Hours/Week: 4; Total Marks 100 (Internal 20 & External 80)

CHE5CBP03	FORENSIC SCIENCE	L	T	P	C
		4	0	0	4
Objectives	To study some fundamental aspects of forensic science				
Course Outcome(s)					
CO1	To learn Crime investigation through diagnosis of poisoning and postmortem				
CO2	To acquire knowledge about explosions, the causes (gelatin sticks, RDX etc) and the security measures				
CO3	To understand the methods of detecting forgery in bank and educational records				
CO4	To acquire a comprehensive knowledge about tracks and traces				
CO5	To understand the chemical methods used in crime investigation.(Medical aspects)				

Module 1: Poisons (12 Hrs)

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

Module 2: Crime Detection (12 Hrs)

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

Module 3: Forgery and Counterfeiting (12 Hrs)

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

Module 4: Tracks and Traces (18 Hrs)

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

Module 5: Medical Aspects (18 Hrs)

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

References:

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

SEMESTER 5

CHE5CBP04: NANOSCIENCE AND NANOTECHNOLOGY

Total Hours: 72; Credits: 4; Hours/Week: 4; Total Marks 75 (Internal 15 & External 60)

CHE5CBP04	**NANOSCIENCE AND NANOTECHNOLOGY**	L	T	P	C
		4	0	0	4
Objectives	To study the fundamentals of nanoscience and nanotechnology				
Course Outcome(s)					
CO1	To study the basic concepts of nanotechnology and the historical landmarks in this area.				
CO2	To learn the terms and concepts of Nanoscience and different nanosystems like nanoparticles, nanotubes, nanowires and other low-dimensional systems				
CO3	To study the principal properties of nanomaterials and the techniques used to interpret it.				
CO4	To manipulate nanomaterials in areas such as biology, biotechnology medicine, medical diagnosis, sensors etc.				
CO5	To learn the main social, economic and ethical issues related to Nanotechnology				

Module 1: Nanomaterials **(18 Hrs)**

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

Module2: Nanoscience (18 Hrs)

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

Module 3: Seeing the nanoworld **(18 Hrs)**

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

Module 4: Applications of nanotechnology **(18 Hrs)**

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

References:

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

SEMESTER 5

CHE6D01: CBCSS PROJECT GUIDELINES - BSc CHEMISTRY PROGRAMME

PROJECT

The compulsory project work is a two credit course that can be carried out individually or as a group of three. However, the viva-voce examination on this will be conducted individually. The project completed as lab work under the guidance of a supervising teacher. It is to be submitted during the practical examination for external valuation.

TOPIC SELECTION

The choice is entirely personal with the help of a teacher from the area of interest or career prospects of students which can be done in the college library.

PROJECT WORK AND EXPERIENTIAL LEARNING

Project work is the best way to practice what you have learned. It provides an opportunity to investigate a problem by applying concepts in a scientific manner. It enables the application of conceptual knowledge in a practical situation and to learn the art of conducting a study in a systematic way and presenting its findings in a coherent report.

A MODEL PROJECT DESIGN

1. Selection of atopic
2. Pilot survey- a trial run
3. Significance
4. Review of literature
5. Coverage (Sample and period of study)
6. Data source
7. Methods of analysis, i.e., tools and techniques
8. Limitation of the study
9. Chapter outline
10. Result chapters
11. Conclusion

STRUCTURE OF THE PROJECT

1. Title page
2. Name of the candidate, name and designation of the supervising teacher
3. Declaration of the student

4. Content
5. Introduction
6. Objective
7. Materials and methods
8. Results and discussion
9. Conclusion
10. References

PROJECT GUIDELINES

Project can be done in about 18 hours and shall be of 10-15 pages in writing. Project reports shall be prepared and submitted to the department at the end of the sixth semester and are to be produced before the practical examiners. The valuation will be done in two stages.

Internal evaluation (the supervising teacher will assess the project and award marks).

External evaluation to be done by the practical examiners.

PROJECT EVALUATION

Components of Project evaluation	**Marks**
Internal Evaluation*	20
Dissertation (end semester)	50
Viva Voce(end Semester)	30

Components of Project Internal evaluation *

Components of internal evaluation	**Marks**
Relevance and Contents	5
Analysis and Presentation	5
Presubmission Presentation and viva	10

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

SEMESTER 6

CHE6COR09 - INORGANIC CHEMISTRY – III

(ADVANCED INORGANIC CHEMISTRY)

Total Hrs: 54; Credits: 3; Hrs/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE6COR09	INORGANIC CHEMISTRY –III (ADVANCED INORGANIC CHEMISTRY)	L	T	P	C
		3	0	0	3
Objectives	To gain detailed knowledge about different analytical techniques and their applications, nanoscience. To introduce the role of metals in biological systems. To get familiarise with organometallic compounds. To provide a basic understanding of different research methodologies in science.				
Course Outcome(s)					
CO1	To understand the separation, purification, thermal and chromatographic techniques				
CO2	To understand the important analytical and instrumental tools used for practicing chemistry				
CO3	To understand the classification, properties and applications of organometallic compounds				
CO4	To study the methods of preparation, properties, structure and bonding of metal carbonyls and metal clusters				
CO5	To understand the role of metals in biological systems.				
CO6	To understand the methods behind research				
CO7	To understand the preparation and applications of nanomaterials				
CO8	To apply these skills in the analysis of experimental data in chemistry practical				

Module I: Analytical Techniques (9 Hrs)

1.1. Separation and purification techniques – filtration, crystallization and precipitation – fractional distillation, solvent extraction.

1.2. Gravimetric analysis: Unit operations in gravimetric analysis – illustrations using iron and barium estimation.

1.3. Thermo analytical methods: Principle of thermo gravimetry, differential thermal analysis, differential scanning calorimetry. Applications - TGA of calcium oxalate monohydrate, DTA of calcium acetate monohydrate.

1.4. Chromatography: Column Chromatography - Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications. Thinlayer chromatography-principle choice of adsorbent and solvent Preparation of ChromatoplatesRf-Values, significance of Rf values. Paper Chromatography-Principle, Solvents used, Development of Chromatogram ascending, descending and radial - paper chromatography. Ion - Exchange Chromatography – Principle -Experimental techniques. Gas Chromatography - Principle – Experimental techniques - Instrumentation and applications. High Performance Liquid Chromatography (HPLC) - Principle-Experimental techniques, instrumentation and advantages.

Module 2: Organometallic Compounds (9 Hrs)

Definition, classification of organometallic compounds, , classification on the basis of hapticity, naming of organometallic compounds. Catalytic properties of organometallic compounds - alkene hydrogenation, synthesis of water gas – shift reaction, Zeigler-Natta polymerisation, 18 electron rule, metal-alkene complexes, metal-alkyne complexes, carbene and carbyne complexes. Metallocenes – ferrocene (preparation and structure only). Zeise's salt – preparation, properties and structure.

Module 3: Metal carbonyls and metal clusters (9 Hrs)

Preparation and properties of mononuclear carbonyls. Structures of $Mo(CO)_6$, $Fe(CO)_5$ and $Ni(CO)_4$. Polynuclear carbonyls, bridged carbonyls and bonding in carbonyls. Metal clusters - carbonyl and halide clusters, low nuclearity carbonyl clusters and high nuclearity carbonyl clusters, electron counting schemes for $Rh_6(CO)_{16}$ and $[Os_6(CO)_{18}]^{2-}$, metal only clusters (Zintl ions). Metal-halide cluster, Quadruple bond – structure of $[Re_2CI_8]^{2-}$.

Module 4: Bioinorganic Chemistry (9 Hrs)

Essential and trace elements in biological systems, myoglobin and haemoglobin, role of myoglobin and haemoglobin in biological systems, mechanism of oxygen transport, cooperativity, Bohr effect. Vitamin B12 (structure not expected) Metalloenzymes of zinc, inhibition and poisoning of enzymes. Electron carriers – cytochromes. Role of alkali and alkaline earth metals in biological systems, Na/K pump. Biological function and toxicity of metals – Fe, Cu, Zn, Cr, Mn, Ni, Co, Cd, Hg and Pb, treatment of metal toxicity.Anti cancer drugs – Cisplatin and carboplatin

Module 5: Research in Science (4 Hrs)

Selecting a topic – hypothesis-design of experiment: variables, correlation and causality, sampling, use of controls, experimental bias, analysis, results, discussion of results, models. Summary of the scientific methods.Writing Science.

Module 6: Nano materials (9Hrs)

Nano materials – Introduction, General method of synthesis – chemical precipitation, mechano-chemical method, micro emulsion method, reduction technique, chemical vapour deposition and sol-gel method (brief study).Synthesis, Properties and applications of fullerenes and carbon nano tubes.

Module 7: Data Analysis (5Hrs)

Units, significant digits, rounding, scientific and prefix notation, graphing of data -Precision and accuracy – Types of errors – Ways of expressing precision – Ways to reduce systematic errors - reporting analytical data ,Statistical treatment of analytical data – population and samples –Mean and standard deviation –distribution of random errors.

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6. J. D. Lee, Concise Inorganic Chemistry 5th Edn., Blackwell Science, London, 1996.
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8. N.N. Greenwood and A. Earnshaw, Chemistry of the elements 2nd Edn, Butterworth, 2011.
9. G. L. Meissler, D. A Tarr, Inorganic Chemistry, Pearson Education, 2008.
10. J.A. Lee, Scientific Endeavor, Pearson Education India, 2010.
11. V.S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009.
12. T. Pradeep, Nano; The Essentials, McGraw-Hill education, New Delhi, 2006.
13. J. Mendhan, R.C. Dehney, J.D. Barnes and M.J. Kthormas, Vogel's Textbook of Quantitative Chemical Analysis, 6th Edn., Pearson Education Ltd., 2000.
14. G.D. Christian, Analytical Chemistry, John Wiley and Sons, 2007.

Further Reading

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2. F.A. Cotton and G.Wilkinson, Advanced Inorganic Chemistry 6th Edn., John Wiley,New York, 1999.
3. A.G Sharpe, Inorganic Chemistry, 3rd Edn. Pearson, 2012.
4. W.D. Callister, Materials Science and Engineering- an introduction, Wiley, New
    a. York, 1991.
5. J.M. Martinez-Duart, R.J. Martin-Palma and F. Agullo-Rueda, Nanotechnology for microelectroics and optoelectronics, Elsevier, Amsterdam, 2006.
6. R. Booker and E. Boysen, Nanotechnology, Wiley India Pvt Ltd, 2008.
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8. D.F. Shriver and P.W. Atkins, Inorganic Chemistry, 3rd Edn., Oxford University
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SEMESTER VI

PROGRAMME: B.Sc. CHEMISTRY

CHE6COR09 - INORGANIC CHEMISTRY – III

(ADVANCED INORGANIC CHEMISTRY)

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	9	2	1	1	4
2	9	2	3		5
3	9	2	1	1	4
4	9	2	1	1	4
5	4	1	1		2
6	9	1		1	2
7	5	2	2		4
		12	9	4	**25**

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Sixth Semester

Core Course: Chemistry

CHE6COR09 - INORGANIC CHEMISTRY – III

(ADVANCED INORGANIC CHEMISTRY)

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

PART A (Answer any 10 questions)

1. What are essential and trace elements? Give one example for each.
2. What are nanomaterials? Give one example.
3. What is meant by sample and variable?
4. Give one method of preparation for each of $Ni(CO)_4$ and $Fe(CO)_5$.
5. What do you mean by accuracy and precision?
6. What is the biological function of zinc in the body?
7. Draw the structure of $Fe_3(CO)_{12}$
8. What are fluxional molecules? Give one example.
9. What are sandwich compounds? Give one example.
10. Define the term R_f value.
11. Define the term chromatogram.
12. What is the significant digit of 4.1230 and 0.110?

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. Explain the method of preparation, properties and structure of Zeise's salt.
14. Explain the details to conduct a research project.
15. What are different types of errors.
16. Classify organometallic compound on the basis of carbon-metal bond.
17. Write a note on Zeigler-Natta Polymerization
18. What is the principle of Thin layer chromatography? What are its applications.
19. What are the ways to reduce systematic errors.
20. What are quadruple bonds? Explain.
21. Give a brief account of Metalloenzymes.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Discuss briefly on Gas chromatographic principle, experimental technique and applications.
23. Give a brief account of Chemical Vapour Deposition and Micro emulsion method. Also describe the properties and applications of Fullerenes and nanotubes.
24. Give a brief account of structure and bonding in metal clusters.
25. What is co-operativity of haemoglobin? Explain the role of haemoglobin and myoglobin in the oxygen transport mechanism in the human body.

(2x10=20 Marks)

SEMESTER 5

CHE6COR10 - ORGANIC CHEMISTRY – IV
(ADVANCED ORGANIC CHEMISTRY)

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE6COR10	**ORGANIC CHEMISTRY –IV (ADVANCED ORGANIC CHEMISTRY)**	L	T	P	C
		3	0	0	3
Objectives	To give the students a thorough knowledge about the mechanisms of reactions of some selected functional groups in organic compounds. To provide a basic understanding of different spectral techniques and their applications in simple molecules. To give an outline of applied organic chemistry and the applications of organic chemistry in various spheres of chemical sciences. To familiarize the students with the role and opportunities of chemistry as a discipline in modern civilization.				
Course Outcome(s)					
CO1	To understand the chemistry of nitro compounds, amines, heterocyclics				
CO2	To understand the basic spectroscopic techniques				
CO3	To elucidate the structure of simple organic compounds using spectral techniques.				
CO4	To understand and distinguish various pericyclic and photochemical reactions				
CO5	To understand the role of chemistry in human happiness index and life expectancy				

Module I: Organic compounds containing Nitrogen and Heterocyclic compounds

(18 Hrs)

1.1 Nitro compounds (3 Hrs): nitromethane- tautomerism- Difference between alkyl nitrites and nitroalkanes. Reduction products of nitrobenzene in acidic, neutral and alkaline media- electrolytic reduction and selective reduction of poly nitro compounds- formation of charge transfer complexes.

1.2 Amines (5 Hrs): Preparation of alkyl and arylamines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds, Gabriel-Phthalimide reaction, Hoffmann bromamide reaction. Isomerism, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines- Structural features affecting basicity of aliphatic and aromatic amines. Quaternary amine salts as phase-transfer catalysts. Comparative study of aliphatic and aromatic amines.

1.3 Diazonium salts: (3 Hrs)

Preparation, structure, synthetic applications of benzene diazonium chlorides, azo coupling-. Preparation and uses of Phenyl hydrazine. Diazomethane - preparation, structure and synthetic uses. Arndt Eistert synthesis-mechanism –Wolff rearrangement.

1.4 Heterocyclic compounds (7 Hrs)

1.5 Structure and aromaticity of five- and six-membered rings containing one heteroatom.Synthesis and reactions of furan and thiophene (any one method), pyrrole (Paal Knorr synthesis), pyridine (Hantzsch synthesis), piperidine (any one method), indole (Fisher indole synthesis), quinoline (Skraup synthesis) and isoquinoline (Bischler – Napieralskii synthesis).Comparative study of the basicity of pyrrole, pyridine and piperidine with amines.

Module 2: Structure elucidation using spectral data (14 Hrs)

2.1. UV Spectroscopy: Types of electronic transitions, λ_{max}, chromophores and auxochromes, bathochromic and hypsochromic shifts. Distinction between cis and trans isomers.

2.2. IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O and N containing functional groups; Effect of H-bonding, conjugation and ring size on IR absorptions. Fingerprint region and its significance. Application in functional group analysis.

2.3. NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift, Spin – Spin coupling and coupling constant, Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.

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

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

Module 3: Pericyclic Reactions and Organic photochemical reactions (6 Hrs)

3.1 Pericyclic reactions: Classification- electrocyclic, cycloaddition (DielsAlderreaction) and sigmatropic reactions. Claisen rearrangement (with mechanism).

3.2. Photochemical reactions: Introduction- Photochemical versus Thermal reactions, Jablonski diagram, Fluorescence and Phosphorescence.Photosensitisation. Norrish reactions of acyclic ketones. Patterno-Buchi reaction, Photo-Fries rearrangement (with mechanism).

Module 4: Applied Organic Chemistry **(16 Hrs)**

2.1. Chemotherapy: (3 Hrs)

Drugs: Introduction, Elementary idea of the structure, therapeutic uses and mode of action of the following drugs: Sulphanilamide, Ampicillin, Chloramphenicol, Chloroquine, Paracetamol and Analgin.Drugs in cancer therapy- Chlorambucil. Application of nanomaterials in medicine. (Synthesis of drugs not required)

2.2. Synthetic Polymers: (5 Hrs):

Polymers: Classification. Polymerization reactions-Types of polymerization-free radical, cationic and anionic polymerizations (including mechanism). Synthesis and applications of the following polymers- Polyesters- terephthalates, polyamides- Nylon 6 and Nylon 6,6, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes, PVC and Teflon. Plastic identification codes, Biodegradable polymers: PGA, PLA and PHBV. Synthetic rubbers– SBR and Nitrile rubber.

2.3. Supramolecular Chemistry: (2 Hrs)

Introduction-Molecular recognition-Host-guest interactions- types of non-covalent interactions.

2.4. Soaps and Detergents: (2 Hrs):

Soaps- Composition.Types of soaps. Cleansing action of soap, TFM. Synthetic detergents-classification.Comparison between soaps and detergents- Environmental aspects.LAS and ABS detergent.

4.5 Dyes: (4 Hrs)

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

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SEMESTER VI

PROGRAMME: B.Sc. CHEMISTRY

CHE6COR10 - ORGANIC CHEMISTRY – IV

(ADVANCED ORGANIC CHEMISTRY)

Module	Hours Allotted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	6	3	1	10
2	14	1	3	1	5
3	6	1	0	1	2
4	16	4	3	1	8
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Sixth Semester

Core Course: Chemistry

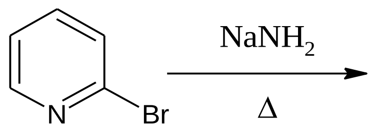
CHE6COR10 - ORGANIC CHEMISTRY – IV

(ADVANCED ORGANIC CHEMISTRY)

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

PART A (Answer any 10 questions)

1. Draw the two tautomeric forms of nitromethane.
2. Which in more basic - aniline or cyclohexyl amine? Explain.
3. Distinguish between alkyl nitrite and nitroalkane.
4. Complete the following reaction.



5. How is diazonium chloride prepared from aniline?
6. What is Hoffmann Bromamide reaction?
7. How many NMR signals would be obtained in the case of $CH_3OCH_2CH_3$?
8. Explain Patterno-Buchi reaction.
9. Name a drug used against Leukaemia.
10. What are the monomers of SBR?
11. What are chromophores? Give an example.
12. Draw the structure of Ampicillin. **(10x1=10 Marks)**

PART B (Answer any 6 questions)

13. How will you separate primary, secondary and tertiary amines? Explain.
14. Explain Arndt-Eistert synthesis with mechanism.
15. Explain the use of quaternary ammonium salts as phase transfer catalysts.
16. An organic liquid containing C, H and O gives an IR absorption at 1720 cm^{-1}. Its ^1H NMR spectrum has a single peak at δ 2.1. Identify the possible structure of the compound and explain your answer.
17. Write a note on anisotropic effects.

18. Explain the fingerprint region in IR spectroscopy.
19. Discuss the various non-covalent interactions in supramolecular chemistry.
20. Draw the structure and explain the mode of action of sulphanilamide.
21. Outline the synthesis of Malachite green.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. (a) What are the products formed when nitrobenzene is reduced under neutral, acidic and alkaline medium?

    (b) Explain Bischler and Napieralskii synthesis.

23. (a) An organic compound having the molecular formula C_4H_8O gives a characteristic band at 275 nm (ε_{max} 17) in its UV spectrum. Its IR spectrum exhibits two important peaks at 2940-2855 cm^{-1}. ^{1}H NMR spectrum of the compound is as follows: δ 2.5 (q, 2H), δ 2.12 (s, 3H), δ 1.07 (t, 3H). Assign a structural formula to the compound.

    (b) How will you determine the molecular mass of a compound by mass spectrometry?

24. (a) What are the various types of polymerization reactions? Explain with the mechanisms.

    (b) Outline the synthesis and uses of Indigo.

25. Illustrate Jablonski diagram to describe the fate of an excited molecule.

(2x10=20 Marks)

SEMESTER 6

CHE6COR11 - PHYSICAL CHEMISTRY – III

(Thermodynamics and Kinetics)

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE6COR11	PHYSICAL CHEMISTRY – III (Thermodynamics and Kinetics)	L	T	P	C
		3	0	0	3
Objectives	To provide an insight into the thermodynamic and kinetic aspects of chemical reactions				
Course Outcome(s)					
CO1	To study the laws of thermodynamics				
CO2	To derive Gibbs-Helmholtz, Clausius-Clapeyron, Gibbs-Duhem equations				
CO3	To derive the relation between K_p, K_c and K_x				
CO4	To derive the phase rule				
CO5	To derive the rate equations for zero, first and second order reactions				
CO6	To study the phase diagrams of one and two component systems				
CO7	To understand the theories of chemical kinetics				
CO8	To get an elementary idea of catalysis including enzyme catalysis				

Module 1: Thermodynamics (18Hrs)

Introduction, definition of thermodynamic terms, intensive and extensive properties, path and state functions, exact and inexact differentials, zeroth law of thermodynamics

First law of thermodynamics, reversible and irreversible processes, internal energy and enthalpy, heat capacity, C_p and C_v relation in ideal gas systems, change in thermodynamic properties of an ideal gas during (i) isothermal/adiabatic, reversible/irreversible processes. Joule-Thomson experiment, Joule-Thomson coefficient μ_{JT} , inversion temperature.

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

Second law: Limitations of first law – statements of second law, Carnot's cycle – efficiency of heat engines, Carnot theorem. Entropy – entropy change for various reversible/irreversible processes, spontaneous and non-spontaneous processes. Change in entropy of an ideal gas with pressure, volume and temperature. Third law of thermodynamics-statement and significance

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

Module 2: Chemical Equilibrium and Phase Equillibria (18 Hrs)

Chemical equilibrium: conditions for chemical equilibrium, Le Chatelier's Principle and its applications, relation between K_c, K_p and K_x, van't Hoff reaction isotherm. Temperature dependence of K_p – van't Hoff equation.

The phase equilibria: Phase rule, derivation of the phase rule, equilibrium between phases – conditions. One component system – water system, sulphur system. Two component systems – solid–liquid equilibrium – simple eutectic, thermal analysis, lead–silver system, formation of compounds with congruent melting point- ferric chloride– water system, formation of compounds with incongruent melting point– sodium sulphate–water system. Three component systems having one partially miscible pair – acetic acid-water–chloroform system

Module 3: Kinetics (18Hrs)

Rate of reaction, rate equation, order and molecularity of reactions, integrated rate expressions for first and second order reactions. Zero order reactions, pseudo order reactions, half -life.

Theories of chemical kinetics: effect of temperature on the rate of reaction, Arrhenius equation, concept of activation energy, Collision theory, transition state theory. Thermodynamic parameters for activation – Eyring equation (derivation not required), enthalpy and entropy of activation. Theory of unimolecular reactions – Lindemann theory.

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

Catalysis: Homogeneous catalysis, enzyme catalysis – Michaelis - Menten equation (no derivation needed). Heterogeneous catalysis – surface catalysis, uni and bi molecular reactions on surface. Elementary idea about autocatalysis.

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1. R.P. Rastogi, R.R. Misra, An Introduction to Chemical Thermodynamics, 6thEdn., Vikas Pub. Pvt. Ltd. 2003.
2. P. Atkins and J Paula, The elements of Physical chemistry, W. H. Freeman, 2009
3. K.K. Sharma, L.K. Sharma, A Textbook of Physical Chemistry, 4thEdn.,Vikas publishing House, 2009.
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Further reading

1. J. Rajaram and J. C. Kuriakose, Thermodynamics, Shoban Lal Nagin Chand & Co. New Jersey, 1986.
2. H. Kuhn and H. D. Fosterling, Principles of Physical chemistry, John Wiley & Sons, Chichester, 1999.
3. W.J. Moore, Basic Physical Chemistry, 4thEdn., Orient Longman. New Delhi, 1976.
4. D.A. McQuarrie, J.D. Simon, Physical Chemistry – a molecular approach, Viva Books Pvt.Ltd, 1998.
5. F.A. Alberty and R. J .Silby, Physical Chemistry, John Wiley.
6. G.M. Barrow, Physical Chemistry, 5thEdn., Tata McGraw Hill, New Delhi, 2004.
7. G.K. Vemulapalli, Physical Chemistry, Prentice-Hall of India Pvt. Ltd. 1997.
8. G.W. Castellan, Physical Chemistry, 3rdEdn., Narosa Publishing House, New Delhi, 2004.
9. K.J. Laidler, Chemical kinetics 3rdEdn., Pearson education, 2004.
10. S.H. Marron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Ltd., 1996.

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SEMESTER VI

PROGRAMME: B.Sc. CHEMISTRY

CHE6COR11 - PHYSICAL CHEMISTRY – III

(Thermodynamics and Kinetics)

Module	HrsAlloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	4	3	1+1/2	8.5
2	18	4	3	1+1/2	8.5
3	18	4	3	1	8
		12	9	4	**25**

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION
Sixth Semester
Core Course: Chemistry, Environment and Water Management
CHE6COR11 - PHYSICAL CHEMISTRY – III
(Thermodynamics and Kinetics)

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

PART A (Answer any 10 questions)

1. Write the relation connecting entropy, enthalpy and Gibb's free energy
2. Total entropy change in a Carnot's cycle is ----------------
3. Which law is the basis of thermometry?
4. Entropy of a crystal substance at 0K is called ---------------
5. Which order reaction the unit of rate constant is same as the unit of rate of reaction.
6. From the Arrhenius equation draw a plot of against for a reaction
7. Give the rate equation for zero order reaction.
8. Differentiate between homogeneous and heterogeneous catalysis.
9. The equilibrium constant for a reaction is found to be unity at a particular temperature. The standard Gibb's free energy change will be -----------------
10. If for a gaseous reaction at temperature T is unity, Find Kc.
11. The degree of freedom of a mixture composed of liquid O_2, gaseous H_2 and ice is ---------------
12. Name the equation for temperature dependence of equilibrium constant.

(10x1=10 Marks)

PART B (Answer any 6 questions)

13. 1 mol of Argon is expanded reversibly at 800K from 10L to 100L. Calculate the work done in the process.
14. What is the physical significance of entropy? Calculate the entropy change at 298K when 2 moles of an ideal gas expand reversibly from an initial volume of 10 dm3 to a final volume of 20 dm3.
15. Explain carnot heat engine. Calculate the maximum efficiency of a steam engine operating between 127°C and 27°C.
16. What is the difference between order and molecularity of a reaction?
17. Discuss the general characteristics of enzyme catalysis. Explain the mechanism of enzyme action using Michaelis-Menten theory.
18. Half-life of a zeroorder reaction and a first order reaction is 300 seconds. Calculate the half-life when the initial concentration of the reactant is doubled.
19. Write the integrated form of van't Hoff equation and explain the terms involved.
20. Calculate the temperature at which for the reaction .

21. Discuss the phase diagram of lead-silver system with the help of its phase diagram.

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. (a) Derive van't Hoff equation for the temperature dependence of equilibrium constant. Also derive its integrated form.

    (b)For a homogeneous reaction, the initial concentrations of the reactants are 1M. If the concentration of C is twice the concentration of A, calculate the equilibrium constant

23. (a) Discuss briefly about Joule Thomson effect. Derive a relationship between Joule- Thomson coefficient and heat capacity at constant pressure.

    (b) State and explain phase rule. Draw and discuss the phase diagram for the water system

24. (a) Describe the Lindemann theory of unimolecular reaction.

    (b) Calculate the activation energy and Arrhenius parameter if the reaction follows the equation where and are constants and is the rate constant of the reaction at temperature.

25. (a) State and explain Nernst distribution law. What are its limitations? Give a thermodynamic derivation of this law.

    (b)State and explain third law of thermodynamics. Explain the steps involved in arriving at third law from Nernst heat theorem.

(2x10 = 20 Marks)

SEMESTER 6

CHE6COR12 - PHYSICAL CHEMISTRY – IV

(Solution chemistry and Electro chemistry)

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

CHE6COR12	**PHYSICAL CHEMISTRY – IV (Solution chemistry and Electro chemistry)**	L	T	P	C
		3	0	0	3
Objectives	To provide an insight into the characteristics of different types of solutions and electrochemical phenomena and also to develop problem solving skill in students				
Course Outcome(s)					
CO1	To study the behavior of binary liquid mixtures, CST, azeotropes, colligative properties				
CO2	To study solubility of gases in liquids				
CO3	To study ionic equilibria and electrical properties of ions in solution.				
CO4	To study the concepts of acids and bases, pH and buffer solutions.				

Module 1: Solutions **(18 Hrs)**

Introduction- Binary liquid solutions – Raoult's law – ideal and non-ideal solutions- ΔG_{mix}, ΔV_{mix}, and ΔS_{mix} for ideal solutions. Vapour pressure-composition and boiling point-composition curves of ideal and non-ideal binary liquid solutions. Fractional distillation of binary liquid-liquid solutions – azeotropic mixtures, distillation of immiscible liquids, solubility of partially miscible liquids. Critical solution temperature (UCST, LCST) – the lever rule.

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

Module 2: Ionic Equillibria (3Hrs)

Introduction-concepts of acids and bases, relative strength of acid-base pairs, influence of solvents, Classification of acids and bases as hard and soft acids and bases. Pearson's HSAB concept, applications, Dissociation constants – acids, bases, and polyprotic acids. Ostwald's dilution law.

Module 3: pH and theory of indicators (3Hrs)

Ionic product of water – pH, Buffer solutions – mechanism of buffer action, Henderson equation. Hydrolysis of salts – hydrolysis constant, degree of hydrolysis, pH of salt solutions Acid-base indicators, theories, determination of pH by indicators, solubility product principle – applications.

Module 4: Electrical Conductance (15Hrs)

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

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

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

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

Module 5: Electromotive force (15 Hrs)

Introduction - Galvanic cells, characteristics of reversible cells. Reversible electrodes – different types, electrode potential – electrochemical series. Representation of cells – emf of cell. Thermodynamics of reversible cells and reversible electrodes – Determination of G, H and S of cell reaction.Emf and equilibrium constant of cell reaction, effect of electrolyte concentration on electrode potential and emf (Nernst equation).

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

Applications of emf measurements – determination of solubility product, determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode. Potentiometric titrations, oxidation reduction indicators.

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

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2. K.L. Kapoor, A Textbook of Physical chemistry, Volume 4, Macmillan India Ltd. 2004.
3. I.N. Levine, Physical Chemistry, 6thEdn., Tata Mc Graw Hill, 2011.
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6. D.A. McQuarrie, J.D. Simon, Physical Chemistry – a molecular approach, Viva Books Pvt.Ltd, 1998.

Further reading

1. H. Kuhn and H. D. Fosterling, Principles of Physical chemistry, John Wiley & Sons, Chichester, 1999.
2. W.J. Moore, Physical Chemistry, 4th Edn., Orient Longman, New Delhi, 1976.
3. F.A. Alberty and R.J .Silby, Physical Chemistry, John Wiley
4. G.M. Barrow, Physical Chemistry, 5thEdn., Tata McGraw Hill, 2006.
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SEMESTER VI
PROGRAMME: B.Sc. CHEMISTRY
CHE6COR12 - PHYSICAL CHEMISTRY – IV
(Solution chemistry and Electro chemistry)

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	18	7	1	2	10
2	3		1		1
3	3	1	1		2
4	15	2	3	1	6
5	15	2	3	1	6
					25

MODEL QUESTION PAPER

B.SC DEGREE (C.B.C.S.S) EXAMINATION

Sixth Semester

Core Course: Chemistry

CHE6COR12 - PHYSICAL CHEMISTRY – IV

(Solution chemistry and Electrochemistry)

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

PART A (Answer any 10 questions)

1. Aquatic life is more comfortable at sea level than at higher altitudes, justify.
2. Give the conditions for a solution to behave ideally.
3. Ionic product of water is temperature dependent, justify.
4. Define kohlrauschs law.
5. What are colligative properties?
6. Give the liquid solutions which show both upper and lower CST
7. Write the schematic representation of cell formed by SHE and Copper electrode.
8. Calculate the charge required to deposit one mole of $Al^{3+.}$ ions from $AlCl_{3.}$
9. What are azeotropes?
10. Draw the vapor pressure-composition curve of binary liquid solutions which show positive deviation.
11. What will be the value of van't Hoff factor for calcium chloride solution which considering complete dissociation?
12. What is the effect of temperature on ionic conductivity?

i. **(10x1=10 Marks)**

PART B (Answer any 6 questions)

13. Give any two methods to determine the PH of solution by EMF measurement.
14. What are fuel cells, Explain?
15. Explain the determination of transport number by moving boundary method.
16. By considering the asymmetry effect and electrophoretic effect explain Deby-Huckel theory of strong electrolyte.
17. What are acid base indicators? Explain the theory.

18. Using pearson HSAB principle how will you classify Hard and Soft acid and bases.
19. Using Nernst equation for electrode potential, Derive Nernst equation for cell potential.
20. Derive Nernst distribution law for particles which undergo association in solution.
21. What is abnormal molecular mass? What is the role of Van't Hoff factor in the case of abnormality?

i. (6x5=30 Marks)

PART C (Answer any 2 questions)

22. Write a note on partially miscible liquid solutions and their CST.
23. (a)How will you calculate the molecular mass of non-volatile un-known solute by osmotic pressure method? Why osmotic pressure method is better than other colligative pressure measurement methods.

    (b)Write a note on Reverse osmosis and its application.
24. Give the electrochemical theory of corrosion. Different forms of corrosion and methods to prevent corrosion.
25. Briefly explain the applications of any three applications of conductance measurement.

(2x10=20 Marks)

SEMESTER 6

CHOICE BASED COURSE - II

(Any one course to be opted from the following courses)

CHE6CBP01: POLYMER CHEMISTRY

Total Hours: 54; Credits: 3; Hours/Week: 2; Total Marks 100 (Internal 20& External 80)

CHE6CBP01	**POLYMER CHEMISTRY**	L	T	P	C
		3	0	0	3
Objectives	To provide a basic understanding of classification, preparation, physical and chemical characteristics and applications of polymers.				
Course Outcome(s)					
CO1	To familiarize the students with the types of polymers, their significance and to understand the chemistry of formation of polymers				
CO2	To understand the structure – property relationships and method for the separation of polymers and determination of molecular weight and to acquire knowledge about stability and degradation of polymers.				
CO3	To acquire knowledge about the polymerization techniques and polymer processing				
CO4	To know the chemistry of individual polymers, their preparation and properties				
CO5	To have an idea about the recent advances in polymer science				

Module 1: Introduction to Polymers (9 Hrs)

History of polymers: Basic concept- monomers and polymers - definition. Classification of polymers on the basis of origin, microstructures, macrostructures and applications (thermosetting and thermoplastics). configuration and conformation of polymers. Plastics, elastomers and fibers. Homo and heteropolymers. Copolymers. Chemistry of polymerization, Chain polymerization, Free radical, ionic, coordination, step polymerization, Polyaddition and polycondensation, miscellaneous ring-opening & group transfer polymerizations. Zeigler Natta polymerization.

Module 2: Physical Properties and Reactions of Polymers (18Hrs)

Properties: Glass transition temperature (Tg)- measurement of Tg- Factors affecting Tg- relationships between Tg and molecular weight and melting point. Importance of Tg. Molecular weight of polymers and degree of polymerization: Number average, weight average, sedimentation and viscosity average molecular weights. Determination of molecular weight of a polymer. Gel permeation chromatography. Structure-property relationships Reactions: hydrolysis-hydrogenation– addition - substitutions-cross-linking vulcanization and cyclisation reactions. Polymer degradation. Basic idea of thermal, photo and oxidative degradations of polymers.

Module 3: Polymerization Techniques and Processing (9 Hrs)

Polymerization techniques: Bulk, solution, suspension, emulsion, melt condensation and interfacial polycondensation polymerizations. Polymer processing: Calendering - die casting, rotational casting - compression. Injection moulding.

Module 4: Chemistry of Commercial Polymers (9Hrs)

General methods of preparation, properties and uses of the following Polymers: Teflon, polymethylmethacrylate, polyethylene, polystyrene, PAN, polyesters, polycarbonates, polyamides, (Kevlar), polyurethanes, PVC, epoxy resins, Phenol - formaldehydes and urea-formaldehyde resins.

Natural rubber from latex, isoprene, processing of latex, applications, vulcanization, synthetic rubbers-preparation , properties and applications.

Module 5: Advances in Polymers (9Hrs)

Biopolymers - biomaterials. Polymers in medical field. High temperature and fire-resistant polymers. Silicones. Conducting polymers- carbon fibers(basic idea only). Blends and polymer composites.

References:

1. Billmeyer F.W, Text book of polymer science, Jr. John Wiley and Sons, 1994.
2. V.R Gowariker, N.V. Viswanathan, and J. Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi, 2006.
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4. M.G. Arora., M. Singh. and M.S. Yadav., Polymer Chemistry, 2nd Revised Edn., Anmol Publications Pvt. Ltd., New Delhi, 1989.

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SEMESTER VI

PROGRAMME: B.Sc. CHEMISTRY

CHE6CBP01: POLYMER CHEMISTRY

Module	Hrs Alotted	Part A 2 Marks 10/12	Part B 5 Marks 6/9	Part C 15 Marks 2/4	Total questions
1	9	2	2	1	5
2	18	4	3	1	8
3	9	2	1	1	4
4	9	2	1	1	4
5	9	2	2		4
		12	9	4	**25**

MODEL QUESTION PAPER
B.SC DEGREE (C.B.C.S.S) EXAMINATION

Sixth Semester

Core Course: Chemistry

CHE6CBP01: POLYMER CHEMISTRY

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

PART A (Answer any 10 questions)

1. What are co-polymers? give an example
2. Draw the structure of PVC and poly(isoprene)
3. Calculate the average molecular weight of Polypropylene whose D.P. is 700
4. Antioxidants are often added during processing. Why?
5. Frying pans are coated with Teflon. Give reason.
6. What are plasticizers?
7. What is meant by isotactic polymers ? Give an example?
8. What is meant by calendaring?
9. What is vulcanization? give an example
10. What is Zeigler-Natta catalyst?
11. Which are the monomers used for the preparation of polycarbonates?
12. Write any two examples for conducting polymers.

(10x2=20 Marks)

PART B (Answer any 6 questions)

13. Write a short note on classification of polymers.
14. What is oxidative degradation of polymers? Explain the process taking a suitable example.
15. Define glass transition temperature? What is its significance? Explain the factors affecting glass transition temperature
16. Write a short note on silicone polymers.
17. Explain viscosity method of or determination of molecular weight of a polymer
18. Compare suspension and emulsion polymerization.
19. Give a brief account of ring opening polymerization with suitable example.
20. Write a note on conducting polymers and their applications.
21. Discuss the method of preparation and any two uses of the following polymers;
    (a) PTFE (b) PAN

(6x5=30 Marks)

PART C (Answer any 2 questions)

22. Write an essay on gel permeation chromatography
23. What is meant by addition polymerization? Briefly explain ionic polymerization.
24. Write a note on synthesis structure, properties and uses of synthetic rubbers
25. Define the term polymerization technique. Give a detailed note on bulk and solution polymerization

(2x15=30 Marks)

SEMESTER 6

CHE6CBP02: NANOCHEMISTRY AND NANOTECHNOLOGY

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

CHE6CBP02	**NANOCHEMISTRY AND NANOTECHNOLOGY**	L	T	P	C
		3	0	0	3
Objectives	To provide a basic understanding of nanochemistry and nanotechnology.				
Course Outcome(s)					
CO1	To study the history, terminology, and scales of nano systems				
CO2	To learn the synthesis and characterization of nano systems				
CO3	To get awareness about electrical and optical properties of nano systems				
CO4	To get a knowledge about the applications of nanomaterials				

Module 1: History **(12Hrs)**

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

Module 2: Characterization of nanomaterials **(15Hrs)**

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

Module 3: Electrical and optical properties of nanomaterials **(15Hrs)**

Electrical and optical properties of nanoparticles- electrical and optical properties of carbon nanotubes- nanocatalysis- nanolithography- nanochemical devices- optoelectronic devices-photodetectors- LEDs and lasers.

Module 4: Applications of nanomaterials (12Hrs)

Nanocrystals- immunogold labeling- applications in medical diagnosis- nanobased drug delivery- applications in biotechnology- nanosensors- self-assembly, nanosensor based on quantum size effects- nanobiosensors- nanomedicines- destructive applications of nanomaterials- nanomaterials in war.

References

1. T. Pradeep, Nano: The Essentials, Mc Graw Hill Publishing Company, New Delhi, 2007.
2. V.S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009
3. C.N.R. Rao and A.Govindraj, Nanotubes and Nanowires, Royal Society of Chemistry, 2005.
4. J.M.M. Duart, R.J.M. Palma and F.A. Rueda, Nanotechnology and microelectronics and optoelectronics, Elsevier, 2002.
5. R. Booker and , E. Boysen, Nanotechnology, Wiley India Pvt. Ltd, 2008.
6. K. J. Klabunde, Nanoscale materials in chemistry, John Wiley and Sons, 2001.
7. C. P. Poole Jr and F J Owens, Introduction to nanotechnology, Wiley India Pvt. Ltd. 2009.
8. http://www.zyvex.com/nanotech/feynman.html.
9. G.L Hornyak, J.Dutta, H.F Tibbals, A.K Rao, Introduction to Nanoscience, CRC Press, 2008.

SEMESTER 6

CHE6CBP03: INDUSTRIAL CHEMISTRY

Total Hours: 54; Credits: 3; Hours/Week: 3; Total Marks100 (Internal 20& External 80)

CHE6CBP03	INDUSTRIAL CHEMISTRY	L	T	P	C
		3	0	0	3
Objectives	To provide an outline of the application of the principles and techniques of chemistry in the manufacture some industrial products				
Course Outcome(s)					
CO1	To understand the requirements to start an industry - different fuels used and the industrial catalysts used				
CO2	To know about different petrochemical industries				
CO3	To understand the manufacture of fertilizers and speciality chemicals.				
CO4	To acquire knowledge about oils, soaps, detergents, sugar industry, leather and pesticide industries				
CO5	To understand the important process of metallurgy, extraction of metals and environmental problems caused by chemical industries.				

Module 1: Industrial Requirements (18 hrs)

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

Module 2: Petrochemical Industries (18 hrs)

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

Module 3: Fertilizers and Speciality Chemicals (9 hrs)

Manufacture - Properties and industrial uses of solvents - DMF, DMSO, THF and Dioxane. Fertilizers - Raw materials, manufacture (flow chart chemical process with equations) of ammonium nitrate, ammonium sulphate, urea, calcium cyanamide, calcium ammonium nitrate, sodium nitrate, ammonium chloride, ammonium phosphate, super phosphate of lime, NPK fertilizers. Manufacture in pure form of the following - Sodium carbonate, Oxalic acid, Potassium dichromate, Perchloric acid.

Module 4: Oils, Soaps and Detergents (9 hrs)

Manufacture of Cl_2, NaOH and Chlorates of Na and K - manufacture of perchlorate. Oils - difference between oils and fats - manufacture of cotton seed oil and soybean oil - refining of oil -manufacture of soaps - toilet and transparent soaps - Detergents - synthetic detergents – surface active agents and their classification - manufacture of anionic, cationic and non ionic detergents and shampoo.

Sugar industry - manufacture of sugar from cane sugar and beet root.

Manufacture of leather - hides - Vegetable and chrome tanning finishing.

Manufacture of DDT, dinitrophenols, BHC, gamexane, malathion, parathion.

References:

1. B.K Sharma, Industrial chemistry, Goel publishing House, Meerut, 2003.
2. C.E Drydens, Outlines of Chemical Technology, 3rd Edn., (Edited and Revised by M. Gopal Rao and M. Sittig) Eastwest press, NewDelhi, 1997.
3. R.V Shreve, Chemical Process Industries, 5th Ed., Mc Graw Hill Pub., 1984.
4. H. Steines, Introduction to Petrochemicals, Pergaman Press, 1961.

SEMESTER 6

CHE6CBP04: ENVIRONMENTAL CHEMISTRY

Total Hours: 54; Credits: 3;Hours/Week: 3;Total Marks 100 (Internal 20& External 80)

CHE6CBP04	ENVIRONMENTAL CHEMISTRY	L	T	P	C
		3	0	0	3
Objectives	To study mainly the chemical aspects of environmental issues				
Course Outcome(s)					
CO1	To study Environmental management and impact assessment				
CO2	To study Toxic effects of pollutants				
CO3	To study Air, water, and soil pollution				

Module 1: Environmental management and impact assessment (5 Hrs)

Basic principles, concepts and scope of environmental planning, Conservation of energy – Renewable and non renewable energy sources-nuclear energy, solar energy, hydrogen, non conventional energy sources. Environmental pollution – concepts and definition.Impact assessment- aim, concepts and methods, Environmental management system –ISO-14001.

Module 2: Chemical toxicology (10 Hrs)

Toxicity -effects, toxic chemicals in the environment, impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, Co, NOx, SO_2, O_3, PAN, CN, pesticides, carcinogenic substances.

Module 3: Air pollution (10 Hrs)

Primary pollutants, hydrocarbons-photochemical smog, particulates, radioactivity, effects of atmospheric pollution - acid rain, ozone layer depletion. Indoor air pollution. Effect of electric and magnetic fields in the environment. Air pollution accidents – Bhopal and Chernobyl.Air quality standards. Sampling and analysis of pollutants – CO, SO_2, H_2S, hydrocarbons, SPM. Noise pollution –measurement, classification, hazards.

Module 4: Water pollution (17 Hrs)

Types, effects and sources of water pollution. Pollution of fresh water, ground water and ocean.Thermal pollution. Sampling and measurement of water quality –odour, colour, EC, turbidity, TDS, salinity, COD, BOD, DO, coliform, pH, acidity, CO_2, alkalinity, hardness, NO_3^-, NO_2^-, NH_3, phosphate, fluoride, chloride, cyanide, sulphide, sulphate and metals- As, Cd, Fe, Pb, Hg, SAR,WQI. Water quality parameters and standard. Case study: Kuttanadu wetland. Waste water treatment techniques.

Module 5: Lithosphere (12 Hrs)

Composition of soil - reactions in soil. Wastes and pollutants in soil. . Sampling procedures and analysis of soil- cation exchange capacity, lime status, lime requirement, gypsum requirement, pH, N, P, K, S, Ca, Mg. Management of solid waste

References

1. A.K. De, Environmental Chemistry, 3rd Edn., New age International Pvt. Ltd. 1996.
2. G.T. Tyler, Living in the Environment, Tomson Brooke/Cole, 2003.
3. N. Manivasakam, Physico-chemical examination of water, sewage and industrial effluents, Pragathi prakashan, 2009.
4. D. Clarson, Soil and water analytical methods, ISBN:81-901483-0-3.
5. R.K. Khitoliya, Environmental Pollution – Management and Control for sustainable development, S.Chand & Company Ltd, 2004.
6. B. B. Kebbekus and S. Mitra, Enveronmental chemical analysis, Blacke Academic & Professional, 1998.
7. S.S.Dara, A Textbook of Environmental chemistry and pollution control, S.Chand & Company Ltd, 2014.
8. R.A. Malaviya, Environmental Pollution and its control under international law, Rawat Publication, 1997.
9. Pramod Singh, Environmental pollution management. Anmol Pub, 1985.
10. G. K. Ghosh, Environmental pollution – A scientific study. APH Publishing Corporation, New Delhi, 1992.
11. Nelson L. Numerow, Industrial water pollution. R.E. Krieger Publishing Company, 1978.
12. James W. Moore and S.Ramamoorthy, Organic chemicals in natural waters, Springer science+ Business media, NewYork, 1984.
13. Hutzinger, Aquatic pollutants, Van Lelyveld and Zoeteman, New York, 1977
14. F. Kreith, Handbook of Solid waste management, Mc Graw Hill Inc, 1994.
15. Peter O' Neil, Environmental Chemistry, Blackie Academic and Professional, London, 2004.
16. S P Mishra and S N Pandey, Essential Environmental Studies, Ane Books Pvt. Ltd, New Delhi, 2011.
17. V K Ahluwalia, Environmental Chemistry, Ane Books Pvt Ltd, New Delhi, 2012.

SEMESTER 6

CHE6CBP05: SOIL AND AGRICULTURAL CHEMISTRY

Total Hours: 54; Credits: 3;Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

CHE6CBP05	**SOIL AND AGRICULTURAL CHEMISTRY**	L	T	P	C
		3	0	0	3
Objectives	To study the fundamentals of soil and agricultural chemistry				
Course Outcome(s)					
CO1	To understand the soil and its formation				
CO2	To know the physical properties of soil and other related aspects				
CO3	To acquire knowledge about chemistry aspects of soil and nitrogen fixing process				
CO4	To understand the chemistry of nutrients that are present in soil				
CO5	To understand the chemistry of pesticides, fungicides and herbicides				

Module 1: Origin of Soil **(9 Hrs)**

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

Module 2: Physical Properties of Soil **(9 Hrs)**

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

Module 3: Chemistry Aspects of Soil **(9 Hrs)**

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

Module 4: Plant Nutrients **(18 Hrs)**

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

Module 5: Pesticides, Fungicides and Herbicides **(9 Hrs)**

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

References:

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

SEMESTER 6

CHE6CBP06: PHARMACEUTICAL CHEMISTRY

Total Hours: 54; Credits: 3;Hours/Week: 3; Total Marks 100 (Internal 20& External 80)

CHE6CBP06	**PHARMACEUTICAL CHEMISTRY**	L	T	P	C
		3	0	0	3
Objectives	To study the fundamental concepts of pharmaceutical chemistry				
Course Outcome(s)					
CO1	To understand the common diseases and the cure				
CO2	To know the terms of pharmacology				
CO3	To understand the mechanism of drug action				
CO4	To acquire knowledge about chemotherapy and the antibiotics				
CO5	To understand the drugs used for diabetes, hypertension, cholesterolemia				
CO6	To acquire knowledge about various health promoting drugs				

Module 1: Introduction (18 Hrs)

Common diseases - Infective diseases - insect-borne, air-borne and water-borne – hereditary diseases. Terminology - drug, pharmacology, pharmacognosy, pharmacodynamics, pharmacokinetics, anti-metabolites. Absorption of drugs - routes of administration of drugs, factors affecting absorption. Assay of drugs - chemical, biological, immunological assays, LD50 and ED50 therapeutic index, drug dosage.

Module 2: Designation of Drugs (9 Hrs)

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

Module 3: Common Body Ailments (9 Hrs)

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

Module 4: Health Promoting Medicines **(18 Hrs)**

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

References

1. J. Ghosh, Pharmaceutical chemistry, S. Chand and Company Ltd., New Delhi, 2006.
2. Lakshmi S., Pharmaceutical chemistry, S. Chand & Sons, New Delhi, 1995.
3. Ashutosh Kar, Medicinal chemistry, Wiley Eastern Ltd., New Delhi, 1993.
4. D. William & T. Lemke, Foyes principles of medicinal chemistry, 5th Edn., BI publishers, 2005,
5. Romas Nogrady, Medicinal chemistry, 2ndEdn., Oxford University, 2004.

SEMESTER 5& 6

PRACTICAL: CHE6P03 -QUALITATIVE INORGANIC ANALYSIS

Total Hrs: 54+54= 108; Credits: 3; Hrs/Week: 3; Total Marks 50 (Internal 10 & External 40)

CHE6P03	**QUALITATIVE INORGANIC ANALYSIS**	L	T	P	C
		0	0	3	3
Objectives	To develop skill in qualitative analysis of inorganic compounds				
Course Outcome(s)					
CO1	To enable the students to develop skills in inorganic qualitative analysis.				
CO2	To understand the principles behind inorganic mixture analysis and to apply it in qualitative analysis.				
CO3	To analyse systematically mixtures containing two cations and two anions.				

General Instructions

1. *Semimicro analysis must be adopted for inorganic qualitative analysis.*
2. *Mixtures containing more than one interfering anions must be avoided.*
3. *If interfering anions are not present, cations may be given from the same group.*
4. *Use safety coat, goggles, shoes and gloves in the laboratory.*
5. *A minimum of 8 inorganic mixtures must be done to appear for the examination*

3. Study of the reactions of the following radicals with a view to their identification and confirmation.
Ag^{+}, Hg^{2+}, Pb^{2+}, Cu^{2+}, Bi^{2+}, Cd^{2+}, As^{3+}, Sn^{2+}, Sb^{3+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, Li^{+}, Na^{+}, K^{+}, NH_4^{+}.
CO_3^{2-}, S^{2-}, SO_4^{2-} , NO_3^{-}, F^{-}, Cl^{-}, Br^{-}, BO_2^{-}, $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, CH_3COO^{-}, PO_4^{3-} , AsO_3^{3-}, AsO_4^{3-} and CrO_4^{2-}

4. Elimination of interfering anions such as F^{-}, BO_2^{-}, $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, PO_4^{3-}, AsO_3^{3-} AsO_4^{3-} and CrO_4^{2-}

5. Systematic qualitative analysis of mixtures containing two acid and two basic radicals from the above list l by Semi-micro method only. *(Minimum of 10 mixtures to be analyzed)*

References

1. A.I. Vogel, A Text Book of Qualitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rd Edn., Longmans, Green and Co. Ltd., 1961.
2. Vogel, A. I., A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis, Longman Green & Co. 1995.

3. V.V. Ramanujam, Inorganic Semi micro Qualitative Analysis, The National Publishing Co., Chennai.

SCHEME OF VALUATION

SEMESTER 5 &6

Core Course: Chemistry, Environment and Water Management
PRACTICAL: CHE6P03-QUALITATIVE INORGANIC ANALYSIS

Part A	**Systematic qualitative analysis of a given mixture containing two acidic and two basic radicals by semi-micro method**		Marks
(a)	Preliminary analysis of salt mixture (Colour, solubility and Flame tests)		3
(b)	Systematic analysis of 2 acid radicals (anions)		
	6)	Identification tests	4
	7)	Preparation of sodium carbonate extract	1
	8)	Confirmatory tests (2 tests per radical)	4
	9)	Spot tests for anions (1 test per radical)	2
	10)	Correctness in the detection of 2 anions	4
(c)	Systematic analysis of 2 basic radicals (cations)		
	23.	Intergroup Separation	4
	24.	Analysis of Individual groups (Two among Group 0 (ammonium) to Group VI)	4
	25.	Spot tests for cations (1 test per radical)	2
	26.	Correctness in the detection of 2 cations	4
Part B	**Procedure for the elimination of an interfering anion**		2
	(Every student should write a detailed procedure of elimination of an interfering anion as suggested by the examiner)		
Part C	**Viva-voice** (Examiners have discretion to make it as short as they think necessary but maximum duration is 15 minutes. Questions should be strictly based on systematic qualitative analysis)		6
Total Marks			**40**

MODEL QUESTION PAPER
BSc DEGREE (C.B.C.S.S) EXAMINATION
Fifth and Sixth Semester
Core Course: Chemistry
PRACTICAL: CHE6P03-QUALITATIVE INORGANIC ANALYSIS

Time: 3 Hrs. **Total Marks: 40**

PART A

1. Systematic qualitative analysis of a given mixture containing two acidic and two basic radicals by semi-micro method (32 marks)

PART B

2. Write down (in a separate sheet of answer book) the procedure for the elimination of…………….………………………………as an interfering anion in the systematic qualitative analysis of salt mixture by semi-micro method

(2 marks)

PART C

3. Viva-voice [you will be invited for an oral examination (maximum 15 minutes duration) by examiners at any time during the course of this examination]

(6 marks)

SEMESTER 5& 6

PRACTICAL:CHE6P04 – ORGANIC CHEMISTRY PRACTICAL-II

Total Hrs: 36+36= 72; Credits: 2; Hrs/Week: 2; Total Marks 50 (Internal 10 & External 40)

CHE6P04	**ORGANIC CHEMISTRY PRACTICAL –II**	L	T	P	C
		0	0	2	2
Objectives	To make the students understand how to plan and implement advanced organic reactions				
Course Outcome(s)					
CO1	To practice how to purify and separate organic compounds				
CO2	To study the physical properties of organic compounds				

A. Basic Laboratory Skills

1. Solvent extraction – aniline from water - methyl benzoate from water - using ether- Record the yield recovery- (Any two experiments shall be done).
2. Crystallization – Any four compounds using ethyl acetate, ethanol, and water- Record the yield recovery.
3. Soxhlet extraction

B. Chromatography

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

C. Preparations

Single stage Organic preparations involving.-

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

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

The product to be recrystallized and purity checked by TLC and melting point.

References

1. F.G. Mann and B.C. Saunders, 'Practical Organic Chemistry' 4thEdn., Pearson Education Ltd, 1960.
2. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, Including Qualitative Organic Analysis English Language Book Society Longman, 1978.
3. V.K. Ahluwalia and S. Dhingra, Comprehensive Practical Organic Chemistry, Universities Press, 2004.
4. Gem Mathew, Practical Organic Chemistry.

SCHEME OF VALUATION
SEMESTER 5 &6

PROGRAMME: B.Sc. CHEMISTRY

CHE6P04 – ORGANIC CHEMISTRY PRACTICAL-II

Q. No.	Mark Division	Total
1	Principle :**3** Procedure: **2**	**5**
2	Equation and substitution of values: **2** Result: **2**	**4**
3	Yield: 2 + 2 =**4**, Quality: 2+2 = **4**	**8**
4	Quality: **4** + Rfvalue :**4**	**8**
5	Crude: Quantity: **5** Quality: **5**, Recrystallised: Qnty: **2** + Qual: **3**	**15**

MODEL QUESTION PAPER
BSc DEGREE (C.B.C.S.S) EXAMINATION
SEMESTER 5 &6
PROGRAMME: B.Sc. CHEMISTRY
CHE6P04 – ORGANIC CHEMISTRY PRACTICAL-II

Time: 3hrs **Total Marks: 40**

Note: **Q1.** Ask any one method from Q.No.5

Q2. Dilution of $HCl/H_2SO_4/HNO_3$/HAc/NaOH/Oxalic acid etc.

Use equations $V_1N_1 = V_2N_2$ or $V_1M_1 = V_2M_2$

Q3. Aniline-water/Phenol/water/Ethyl acetate-water/Ethyl benzoate-water etc.

Q4. o-Nitro aniline-p-Nitro aniline/o-Nitro phenol- p-Nitro phenol etc.

Q5.

1. Conversion of Benzyl chloride/ benzyl alcohol/toluene to Benzoic acid by side chain oxidation.
2. Conversion of Benzaldehyde to Benzoic acid by oxidation.
3. Iodoform from acetone.
4. Ethyl/methyl benzoate to Benzoic acid by hydrolysis.
5. Methyl salicylate to salicylic acid by hydrolysis.
6. Nitrobenzene to m-dinitro benzene by nitration.
7. Preparation of Dibenzal acetone from Benzaldehyde

SEMESTERS 5 & 6

PRACTICAL: CHE6P05 – PHYSICAL CHEMISTRY PRACTICALS

Total Hrs: 54+54= 108; Credits: 3; Hrs/Week: 2; Total Marks 50 (Internal 10 & External 40)

CHE6P05	**PHYSICAL CHEMISTRY PRACTICALS**	L	T	P	C
		0	0	3	3
Objectives	The students will learn how to carry out the various physical chemistry experiments and gain skills to explain them.				
Course Outcome(s)					
CO1	To attain lab skills for performing various physicochemical experiments				
CO2	To study how to keep record of instrumental parameters and observations				
CO3	To understand the concepts in theory by performing experiments				

1. Viscosity – percentage composition of a mixture.
2. Heat of solution – KNO_3, NH_4Cl
3. Heat of neutralization strong acid with strong base.
4. Determination of equivalent conductance of an electrolyte
5. Conductometric titration – strong acid *vs.* strong base.
6. Determination of partition coefficient of non-volatile solute between two immiscible solvents. E.g. I_2 between CCl_4 and water.
7. Transition temperature of salt hydrates. (Sodium thiosulphate, sodium acetate)
8. Critical solution temperature. Phenol-water system
9. Determination of molecular weight by Rast's Method (using naphthalene, camphor or biphenyl as solvent and acetanilide, p-dichlorobenzene etc. as solute.)
10. Kinetics of simple reactions eg. Acid hydrolysis of methyl acetate.
11. Potentiometric titration – Fe^{2+} *vs.* $Cr_2O_7^{2-}$, I^- *vs.* MnO_4^-
12. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant)
13. Determination of equivalence point of potentiometric and conductometric titrations using spreadsheet program.

References

1. W.G. Palmer, Experimental physical chemistry, Cambridge University Press, 1941.
2. J.B. Yadav: Advanced Practical Physical Chemistry, 9thEdn., Goel Publishing House, 1989.
3. R.C. Das and B. Behra, Experimental Physical Chemistry, Tata McGraw hill, New Delhi, 1983.

4. K.K. Sharma and DS Sharma, Introduction to Practical Chemistry, Vikas Publishing House, New Delhi, 1989.

SCHEME OF VALUATION

Semester 5 & 6

CHE6 P04: PHYSICAL CHEMISTRY PRACTICALS

1. Write down the procedure/theory of the experiment in the first five minutes.

Expt. No.	Experiment	Procedure	Data	Graph	Calculation	Accuracy	Total
1	CST unknown Composition	5	5	10	-	20	40
2	Rast's Method	5	5	10	5	15	40
3	Conductometry (manual/spread sheet	5	5	10	5	15	40
4	Potentiometry (manual/spread sheet)	5	5	10	5	15	40
5	Vicosity	5	5	10	-	20	40
6	Heat of Neutralization	5	5	5	10	15	40
7	Mass of salt hydrate by transition temperature	5	5	10	5	15	40

% of Error	Marks
Upto 5% error	Full marks
5-6	Deduct 1 mark for every 0.2 %
Above 6%	Deduct 1 mark for every 0.1 %

MODEL QUESTION PAPER

B Sc PROGRAMME IN CHEMISTRY

Fifth & Sixth Semester

CHE6 P04: PHYSICAL CHEMISTRY PRACTICALS

Time: 3 Hrs **Total marks: 40**

1. Study the variation of Miscibility temperature of Phenol Water system on the addition of KCl. Use the data to determine the concentration of the given solution.
2. Find the molecular mass of the given solute by Rast's method. You are provided with a solvent of known mass and kf-------
3. Determine conductometrically the concentration of the given acid. You are provided withstandardNaOH. Find the equivalence point manually or by using spread sheet programme.
4. Determine by Potentiometric titration the concentration of given Fe^{2+}. You are provided with Standard $KMnO_4$. Determine the concentration manually or with the help of spread sheetprogramme.
5. Determine viscometrically the composition of the given sucrose solution.
6. Determine the heat of neutralization of a strong acid by a strong base.
7. Determine the mass of a given salt hydrate from transition temperature.
   You are provided with K_f = ---------------- and molecular mass of solute = --------------.

SEMESTERS 5 & 6

PRACTICAL: CHE6P06 – GRAVIMETRIC ANALYSIS

Total Hrs: 36; Credits: 1; Hrs/Week: 2; Total Marks: 50 (Internal 10 & External 40)

CHE6P06	**GRAVIMETRIC ANALYSIS**	L	T	P	C
		0	0	2	1
Objectives	To develop skill in quantitative analysis using gravimetric methods.				
Course Outcome(s)					
CO1	To enable the students to develop analytical skills in inorganic quantitative analysis.				
CO2	To understand the principles behind gravimetry and to apply it in quantitative analysis.				

General Instructions

1. For weighing, electronic balance may be used.

2. Use safety coat, goggles, shoes and gloves in the laboratory.

3. A minimum number of 5 experiments must be done, to appearfor the examination.

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

References

1. A.I. Vogel 'A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis': 3rd Edn., ELBS and Longman, London, 1971.
2. J. Bassett, R.C. Denney, G.H. Heffery and J Mendham, 'Vogel's Textbook of quantitative Inorganic Analysis' John Wiley & Sons, 5thEdn., 1989.

SCHEME OF VALUATION

SEMESTER 5 &6

PROGRAMME: B.Sc. CHEMISTRY

PRACTICAL: CHE6P06 – GRAVIMETRIC ANALYSIS

1. Procedure: **5** marks
2. Calculation: **5** marks

Accuracy: **30** marks

(Up to 1% error, give full marks.
1-2%, deduct 1 mark for every 0.1%
2-3%, deduct 1.5 marks for every 0.1%
Above 3%, give 5 marks as grace mark.)

Give 20, 22, 24 ml solution for estimation.

Sl. No.	Expt. Code	Estimation	To precipitate as	Wt in 500 ml
1	G1	Sulphate	$BaSO_4$	19 g K_2SO_4
2	G2	Barium	$BaSO_4$	28 g $BaCl_2$

MODEL QUESTION PAPER
BSc DEGREE (C.B.C.S.S) EXAMINATION
Fifthand Sixth Semester
Core Course: Chemistry
PRACTICAL: CHE6P06 – GRAVIMETRIC ANALYSIS

Time: 3 Hrs **Total marks: 40**

1. Write down the procedure and brief theory of the estimation in question no. 2, in the first 10 minutes in a separate sheet of paper. (5 marks)

2. Estimate gravimetrically the mass of ………………….. in the whole of the given solution of …………………………. (35 marks)

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