

# UNIVERSITY OF KERALA

B.Sc. DEGREE PROGRAMME IN CHEMISTRY  
UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM

SCHEME AND SYLLABI

2017 ADMISSION ONWARDS

Core Courses, Foundation Course II, Open and Elective Courses

## B.Sc. Degree Chemistry Programme

### Aim and Objective of the Syllabi

#### Aim

The B.Sc. Degree Programme in Chemistry covers three academic years consisting of six semesters and aims to provide the students with an in-depth understanding of and training in chemical sciences. The syllabus has been designed to stimulate the interest of the students in chemistry and prepared in order to equip the students with a potential to contribute to the academic and industrial requirements of the society. The new, updated syllabus is based on an interdisciplinary approach and is infused with a new vigour and more depth. Chemistry being an experimental science, due importance is given to the development of laboratory and instrumentation skills.

#### Objective

The main objective is to provide to the students an in-depth understanding of the basic concepts of chemical sciences and enable them with tools needed for the practice of chemistry, which remains a discipline with much stress on experimentation. It attempts to provide a detailed knowledge of the terms, concepts, methods, principles and experimental techniques of chemistry.

#### Course structure

The First Degree programme in Chemistry comprises of fourteen core courses, one project course, two elective courses, one core-specific foundation course in addition to one area-specific foundation course, the complementary courses and language courses. Among the two open/elective courses, the one offered in the fifth semester is open to students from other Majors. The details of the Course Structure are given in Table I. Table II gives the details of the contact hours and credits for the Core Courses, Foundation Course II, Open Course and Elective Course, Table III gives the details of Open Courses and Table IV gives the details of the Elective Courses and Table V gives distribution of Complementary Courses in different Semesters.

First Degree Programme in Chemistry  
Table I : Course structure, Scheme of Instruction and Evaluation

Semester	Course Code	Study component	Instructional hrs/Week		Credit	Duration of Uty. Exam	Evaluation marks		Total Credit
			T	P			CE	ESE	
I	EN1111	English I	5		4	3hrs	20	80	18
	1111	Additional Language I	4		3	3hrs	20	80	
	EN1121	Foundation Course I	4		2	3hrs	20	80	
	MM1131.2	Complementary Course I	4		3	3hrs	20	80	
	PY1131.2	Complementary Course II	2		2	3hrs	20	80	
		Complementary Course Lab of PY1131.2		2	-	-	-	-	
	CH1141	Core Course I	2		4	3hrs	20	80	
		Core Course Lab I of CH1141		2	-	-	-	-	
II	EN1211	English II	4		3	3hrs	20	80	18
	EN1212	English III	5		4	3hrs	20	80	
	1211	Additional Language II	4		3	3hrs	20	80	
	CH1221	Foundation Course II	2	2	3	3hrs	20	80	
	MM1231.2	Complementary Course III	4		3	3hrs	20	80	
	PY1231.2	Complementary Course IV	2		2	3hrs	20	80	
		Complementary Course Lab of PY1231.2		2	-	-	-	-	

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## First Degree Programme in Chemistry Course structure, Scheme of Instruction and Evaluation

Semester	Course Code	Study component	Instructional hrs/Week		Credit	Duration of Uty. Exam	Evaluation		Total Credit
			T	P			CE	ESE	
III	EN1311	English IV	5		4	3hrs	20	80	18
	1311	Additional Language III	5		4	3hrs	20	80	
	MM1331.2	Complementary Course V	5		4	3hrs	20	80	
	PY1331.2	Complementary Course VI	3		3	3hrs	20	80	
		Complementary Course Lab of PY1331.2		2	-	-	-	-	
	CH1341	Core Course II	3		3	3hrs		80	
		Core Course Lab I of CH1341		2	-	-	-	-	
IV	EN1411	English V	5		4	3hrs	20	80	24
	1411	Additional Language IV	5		4	3hrs	20	80	
	MM1431.2	Complementary Course VII	5		4	3hrs	20	80	
	PY1431.2	Complementary Course VIII	3	2	3	3hrs	20	80	
	PY1432.2	Complementary Course Lab of PY1131.2, PY1231.2, PY1331.2 & PY1431.2			4	3hrs	20	80	
	CH1441	Core Course III	3		3	3hrs	20	80	
	CH1442	Core Course IV- Lab I of CH1141, CH1341 & CH1441		2	2	3hrs	20	80	

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Semester	Course Code	Study component	Instructional		Credit	Duration of Uty. Exam	Evaluation		Total Credit			
			T	P			CE	ESE				
V	CH1541	Core Course V	3		4	3hrs	20	80	14			
	CH1542	Core Course VI	4		4	3hrs	20	80				
	CH1543	Core Course VII	4		4	3hrs	20	80				
	CH1544	Core Course VIII Lab II		5	0	3hrs	20	80				
	CH 1545	Core Course IX Lab III		4	0	3hrs	0	0				
	1551	Open Course	3		2	3hrs	0	0				
		Project		2	-	-	-	-				
VI	CH1641	Core Course X	3		4	3hrs	20	80	28			
	CH1642	Core Course XI	4		4	3hrs	20	80				
	CH1643	Core Course XII	4		4	3hrs	20	80				
	CH1544	Core Course VIII Lab II		8	3	6hrs	20	80				
	CH 1545	Core Course IX Lab III			2							
	CH1644	Core Course XIII Lab IV			3					6hrs	20	80
	CH1645	Core Course XIV Lab V			2							
	CH1661.1/ CH1661.2/ CH1661.3/ CH1661.4	Elective Course	3		2	3hrs	20	80				
	CH1646	Project and Factory Visit		3	4	Viva	-	100				

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A) Language Courses = 9, B) Foundation Courses = 2, C) Complementary Courses = 9, D) Core Courses = 14, E) Open Course = 1, F) Elective Course = 1, G) Project = 1 Total Courses = 9+2+9+14+1+1+1 = 37. Total Credits = 18+18+18+24+14+28 =120.

B.Sc. Degree Programme in Chemistry  
Table II. Scheme of Instruction of Core Courses, Foundation Course II, Open Course and Elective Course

Course number	Course Code	Course Title	Semester I		Semester II		Semester III		Semester IV		Semester V		Semester VI		Total		
			Hrs		credit		hrs		credit		hrs		Credit		Hrs	credit	
			T	P	T	P	T	P	T	P	T	P	T	P			credit
C.C. I	CH1141	Inorganic Chemistry I	2		4											2	4
F.C. II	CH1221	Methodology and Informatics			2	2	3									4	3
C.C. II	CH1341	Inorganic Chemistry II					3	3								3	3
C.C. III	CH1441	Organic Chemistry I							3	3						3	3
C.C. IV	CH1442	Lab I of CH1141, CH1341, CH1441 (Inorganic Qualitative Analysis)		2				2		2	2					6	2
C.C. V	CH1541	Physical Chemistry I									3	4				3	4
C.C. VI	CH1542	Inorganic Chemistry III									4	4				4	4
C.C. VII	CH1543	Organic Chemistry II									4	4				4	4
C.C. VIII	CH1544	Lab Course II of CH1541, CH1542 & CH1543 (Inorganic volumetric analysis)									5	3				5	3
C.C. IX	CH1545	Lab Course III of CH1541, CH1542 & CH1543 (Physical chemistry experiments)									4	2				4	2
O. C	CH1551	Any One of the Options									3	2				3	2
C.C. X	CH1641	Physical Chemistry II											3	4		3	4
C.C. XI	CH1642	Organic Chemistry III											4	4		4	4
C.C. XII	CH1643	Physical Chemistry III											4	4		4	4
C.C. XIII	CH1644	Lab Course IV (Organic chemistry experiments)												5	3	5	3
C.CXIV	CH1645	Lab Course V (Gravimetry)												3	2	4	2
E.C.	CH1661	Any one of the options											3	2		3	2
C.C.XV	CH1646	Project									2			3	4	5	4
		Factory Visit															

C.C.- Core Course, F.C.-Foundation Course, O.P.-Open Course, E.C- Elective Course T-Theory, P-Practical.  
 Since the other requirements as the components of continuous evaluation are satisfied, for each of the practical courses in semester V is given a credit of 2 even though the examinations are on semester 6.

B.Sc. Degree Programme in Chemistry  
 Table III. Distribution of Open Course offered to students of other disciplines Semester V

Semester	No. of Hours / Week		Credits	Course Code	Title of the Course	Instructional Hours
	Lectures	Practicals				
5	3	-	2	CH1551.1	Essentials of Chemistry	54
				CH 1551.2	Fundamentals of Chemistry & Its Application to Everyday Life	
				CH 1551.3	Environmental Chemistry	

B.Sc. Degree Programme in Chemistry  
 Table IV. Distribution of Elective Course offered in Semester VI

Semester	No. of Hours / Week		Credits	Course Code	Title of the Course	Instructional Hours
	Lectures	Practicals				
6	3	-	2	CH1661.1	Supramolecular, Nano Particles and Green Chemistry	54
				CH 1661.2	Computational, Combinatorial and Physical Organic Chemistry	
				CH 1661.3	Polymer chemistry	
				CH 1661.4	Biochemistry	

Table V  
Distribution of Complementary Courses in different Semesters  
Complementary Courses -4  
Total Credits – 14 One Semester – 18 Weeks

Sem	Hours/Week		Number Of Credits	Course	Title of Course	Instructional Hours
	Theory	Practical				
1	2	2	2	CH1131		2×18 = 36 2×18 = 36
2	2	2	2	CH1231		2×18 = 36 2×18 = 36
3	3	2	3	CH1331		3×18 = 54 2×18 = 36
4	3	2	3 4	CH1431 CH1432		3×18 = 54 2×18 = 36

#### GENERAL ASPECTS OF EVALUATION

#### MODE OF EVALUATION - COMMON TO CORE, ELECTIVE, COMPLEMENTARY AND FOUNDATION COURSES

Evaluation of each course shall involve Continuous Evaluation (CE) of 20 marks and End Semester evaluation (ESE) of 80 marks .

#### CONTINUOUS EVALUATION FOR LECTURE COURSES

The Continuous evaluation will have 20 marks and will be done continuously during the semester. CE components are

- (i) Attendance for lecture and laboratory sessions (to be noted separately where both lecture and laboratory hours have been specified within a course);
- (ii) Assignment /seminar and
- (iii) Test

The weightage is shown in Table I.1. There will be two class tests for which, the better of the two marks obtained will form part of CE. Seminar for each course to be organized by the course teacher and assessed along with a group of teachers in the Department. The topic selection by the student for assignments/seminar will be with the approval of the course teacher.



No	Component	Marks
1	Attendance	5
2	Assignment / Seminar	5
3	Tests	10
	Total	20

## EVALUATION OF THE ASSIGNMENTS AND SEMINAR

The assignment typed/written on A4 size paper should be 4-6 pages. The minimum duration of the seminar is fifteen minutes and the mode of delivery may use audio-visual aids if available. The seminar is to be conducted within the contact hour allotted for the course.

Mode of Assignments / Seminar Evaluation		
No	Main Component	Marks
1	Adherence to overall structure & submission deadline	All four main components present & satisfactory : 5 Only three : 4 Only two : 3 Only one : 2
2	Content & grasp of the topic	
3	Lucidity / Clarity of presentation	
4	References / Interaction/Overall effort	

The following explanatory guide lines in Table I.1.1.1 are suggested tentatively for the assessment of each of the above main components as satisfactory or not.

## QUESTION PAPER PATTERN FOR CONTINUOUS EVALUATION TEST

1. The theory examination has a duration of 1.5 hours and a maximum mark of 40
2. Each question paper has three parts: A, B & C
3. Part A contains ten questions. Each question carries 1 mark. Students have to answer all 10 questions. The answer may be in the forms – one word/one sentence.
4. Part B contains twelve questions. Out of these twelve questions, the students have to answer 7 questions. Each question carries 2 marks. Each answer should contain four points. (Short Answer type).
5. Part C contains nine questions of which the candidate has to answer 4 questions. Each question carries 4 marks. The answer must contain 8 points (Short Essay type).

Question paper should contain 20% hard,60% medium and 20% easy questions

<b><u>QuestionPaperPatternforTest</u></b>		
<u>QuestionNo</u>	<u>Typeof Question</u>	<u>Marks</u>
Part A: 1-10	All / one word/one sentence	1X10=10
Part B: 11-22	7out of 12; Short Answer	7 X2=14
Part C: 23-31	4 out of 9; Short Essay	4 X4= 16
TOTAL	1 out of 2; Essay	40 marks

## CONTINUOUS EVALUATION FOR LABORATORY COURSES

The Continuous evaluation will have 20 marks. The ESE of inorganic qualitative analysis will be done only in the IV semester and similarly the ESE of physical chemistry experiments and volumetric analysis will be done only in the VI semester. But the corresponding CE are calculated from all the semesters in which there is attendance for laboratory sessions.

No	Component	Marks
1	Attendance	5
2	Lab test	5
3	Record	5
4	Punctuality	5
	Total	20

### I. 2. 1. EVALUATION OF THE RECORD

On completion of each experiment, a report should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, and tables of data collected, equations, calculations, graphs, and other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

CE for Laboratory Record		
No	Sub Component	Marks
1	Punctual submission and Neat presentation	All four sub-components present & satisfactory : 5  Only three : 4  Only two : 3  Only one : 2
2	Record of more than 90% experiments in the syllabus	
3	Calculations and absence of errors/mistakes	
4	Accuracy of the result	

During ESE external examiner has to verify that the Lab report of experiments and certified by the tutor and HOD

#### END SEMESTER QUESTION PAPER PATTERN & GUIDELINE FOR QUESTION PAPER SETTERS

1. The theory examination has a duration of 3 hours
2. Each question paper has four parts: A, B, C and D
3. Part A contains ten questions. Student have to answer all 10 questions. Each question carries 1 mark. The answer may be in the forms – one word/one sentence.
4. Part B contains twelve questions. Out of these twelve questions, the students have to answer eight questions. Each question carries 2 marks. Each answer should contain four points. (Short Answer type).
5. Part C contains nine questions of which the candidate has to answer six questions. Each question carries 4 marks. The answer must contain 8 points (Short Essay type).
6. Part D contains four questions of which the candidate has to answer two. Each question carries 15 marks. Essay type question. Each question carries two or three subdivisions (10+5) or (5+5+5) pattern.
7. The total weightage for the entire questions to be answered is 80 marks.
8. Question paper should contain 20% hard, 60% medium and 20% easy questions.
9. Question paper setter shall submit a detailed scheme of evaluation along with question paper.
10. Question paper setters should refer standard text books for setting question papers, based on the syllabus.

<b><u>Question Paper Pattern for Test</u></b>		
<u>Question No</u>	<u>Type of Question</u>	<u>Marks</u>
Part A: 1-10	10 one word/one sentence	10

Part B: 11-22	8 out of 12; Short Answer	16
Part C: 23-31	6 out of 9; Short Essay	24
Part D: 32-35	2 out of 4; Essay	30
		Total = 80-80 marks

SYLLABUS FOR B.Sc. CHEMISTRY PROGRAMME  
Semester – I Core Course - 1 Course Code– CH1141 Credit-4

Inorganic Chemistry I

Lecture -Tutorial-Lab: 2-0-2

36hrs.

### Aim of the Course

The course builds on the plus-two level introductory chemistry and familiarizes theoretical aspects of atomic structure and periodicity. Subsequently, it delves into the principles of acids, bases and nonaqueous solvents. The course will be highlighting the chemistry of hydrogen as well as s-block elements. The course also introduces the students an idea about environmental chemistry and different types of pollution.

### Course objectives

The course helps to learn the students to understand the structure of atom, periodicity and non-aqueous solvents. Upon course completion, the student will be able to appreciate how the inner structure of elements dictates the chemical properties of elements and also understand how the elements are arranged in the periodic table and the properties and application of s -block elements, hydrogen and their compounds.

### Course outline

#### Module I- Atomic Structure and Periodicity

6 hrs.

Introduction to the structure of atom - Dual nature of electron - de Broglie equation - matter waves and electromagnetic waves - experimental verification of de Broglie relation - Heisenberg's uncertainty principle - expression and significance. Wave mechanical concept of the atom - Schrodinger equation (Derivation not required) -. Quantum numbers - Pauli's exclusion Principle - Aufbau Principle – Hund's rule - Electronic configuration of atoms - classification of elements into s, p, d, f blocks - electronegativity-Pauling's scale, Mulliken and Allred - Rochow scale-(Including numerical problems)

#### Module II-Hydrogen

6hrs

Position of hydrogen in the periodic table. - Similarities and difference in properties compared with alkali metals and halogens- Atomic and physical properties of hydrogen; Preparation of hydrogen- Reactions of hydrogen. Nascent, atomic and active hydrogen- Ortho and para hydrogen -Deuterium and tritium –Uses of hydrogen- Hydrogen as next generation fuel-Hydrides- Types of hydrides, properties; water; Hydrogen bond-types-consequences of hydrogen bond. Hydrates; Hardness of water- types- different methods water softening. Heavy water- preparation and properties.

#### Module III-S-Block Elements

9hrs

General characteristics, atomic and ionic radii, ionisation enthalpy, electropositive character, formation of univalent positive ions, hydration of ions, reducing properties, Electrode potentials, characteristic flame colouration, lattice enthalpy, chemical properties, , comparison of lithium with other members of the family, resemblance of lithium and magnesium, uses of alkali metals, properties of alkali metals and their uses, compounds of elements of group 1 – comparative study-oxides, hydroxides, halides, carbonates and bicarbonates General characteristics of group II-atomic and ionic radii, ionisation enthalpy, reducing properties, electrode

potentials, characteristic flame colouration, chemical properties, gradation in properties, comparison of beryllium with other members of the family, Uses of alkaline earth metals, Compounds of alkaline earth metals-Beryllium oxide, beryllium chloride, calcium oxide, calcium hydroxide, calcium cyanamide- preparation and properties. comparison of solubility products of hydroxides and sulphates, Portland cement.

#### Module IV -Acids, Bases and Non Aqueous Solvents

6hrs

Lowery-bronsted and Lewis concepts of acids and bases-introduction to SHAB principle. General properties- classification- self ionization and levelling effect- reaction in non-aqueous solvents - protic and aprotic non aqueous solvents- examples- solutions of metals in liquid ammonia- self ionization of liquid ammonia- liquid SO<sub>2</sub>, liquid HF, alkali metals in liquid ammonia

#### Module V - Environmental Chemistry – Air, Water and Soil Pollution

9 hrs.

Air pollution - ozone layer depletion, ozone hole, protection of ozone umbrella –Air pollution caused by fire works, harmful effects of fireworks, acid rain, green house effect, smog –Classic and photochemical Smog-management of air pollution.

Water pollution: Causes- Heat, industrial waste, sewage water, detergents, agricultural pollutants - treatment of industrial waste water-Activated charcoal, Synthetic resin, reverse osmosis and electro dialysis - Quality of drinking water - Indian standard and W H O standard - Dissolved oxygen - BOD, COD.

Soil pollution - Pesticides, Fertilizers, Industrial waste, plastics - Control of pollution

#### References

1. T.F.Gieryn, Cultural boundaries of science Univ. Chicago Press 1999.
2. The Golem : What everyone should know about science. H.Collins and T.Pinch. Cambridge Univ Press 1993
3. Alexis Leon & Mathews Leon, Computers Today, Leon Vikas
4. SotiSivendraChanthra Contemporary Science Teaching,
5. ManasChanda, "Atomicstructure and Chemical Bonding including Molecular spectroscopy"
6. E.S. Gilreath "Fundamental concepts of Inorganic Chemistry"
7. Puri, Sharma and Kalia "Inorganic Chemistry"
8. Madan "Inorganic Chemistry".
9. Manku , "Theoretical principles of Inorganic Chemistry" -
10. M. C. Dey and J. Selbin "Theoretical Inorganic Chemistry".
11. F A Cotton and G. Wilkinson "Basic Inorganic Chemistry".
12. S. K. Banerji, "Environmental Chemistry".
13. A. K. De "Environmental Chemistry - An introduction"
14. B. K. Sharma "Air Pollution".
15. V. K. Ahluwalia "Environmental Chemistry"
16. G.W. vanLoon and S. J. Duffy "Environmental Chemistry: A global perspective"
17. Puri, Sharma and Kalia "Inorganic Chemistry"

University of Kerala  
Model Question Paper of B.Sc. Chemistry Programme  
2017 onwards  
Semester -I Core Course-1 Course Code - CH1141 Credit-  
4 INORGANIC CHEMISTRY I Time: Three Hours

Maximum Marks: 80

SECTION A (Answer all questions in one word/one sentence. Each question carries 1 mark)

1. Mention about the flame colouration of II group elements.
2. Write an example of classic smog.
3. State Heisenberg's uncertainty principle.
4. What are matter waves?
5. Which is the conjugate base of HF.
6. Define covalent radius.
7. Write the reason for eutrophication?
8. In the stratosphere, fluorine from the CFC's change to which compound.
9. What is active hydrogen?
10. Mention any use of alkali metals.

(1 X 10 = 10marks)

SECTION B (Answer any 8 questions. Each question carries 2 Marks)

11. Calculate the wavelength of electron moving with a velocity of  $10^6 \text{ ms}^{-1}$ .
12. A cricket ball weighing 100g is to be located within  $0.1 \text{ \AA}$ . What is the uncertainty in its velocity?
13. What are eigen values and eigen functions?
14. How first element differs from other elements in a group?
15. What is COD?
16. What are ortho and para hydrogens.
17. Write SHAB principle?
18. Comment about the hydration of alkali metals?
19. State and illustrate Pauli's Exclusion Principle.
20. Distinguish between levelling solvents and differentiating solvents.
21. Write a note on green house effect.
22. What is acid rain? Explain the various types of hydrogen bonds.

(2 X 8 = 16marks)

SECTION C (Answer any 6 questions. Each question carries 4 Marks)

23. Discuss the following reactions in liquid  $\text{SO}_2$ ? (i) Solvation (ii) acid- base reaction
24. Discuss the structure of beryllium chloride
25. Derive Schrodinger wave equation.
26. Briefly explain about the Davisson and Germer's experimental verification of wave nature of electron.
27. What is smog? What are the different types of smog?
28. How ozone layer is depleted?
29. What is the trend of Ionization enthalpy and electron gain enthalpy in the periodic table?
30. What are hydrides? Explain.
31. Discuss about the redox property of alkali metals

(4 X 6 = 24marks)

#### SECTION D

(Answer any 2 questions. Each question carries 15 Marks)

- 32.(a) Briefly discuss about the various air pollutants (5 Marks)
- (b) Write a note on Ozone depletion (5 Marks)
- (c) Explain about the various water quality parameters (5 Marks)
- 33.(a) What are quantum numbers? Explain (5 Marks)
- (b) Write a note on various electronegativity scales (5 Marks)
- (c) Explain about the various rules for writing electronic configuration. (5 Marks)
- 34.(a) What is the difference between inter and intra molecular hydrogen bonding with example.
- (b) Discuss the topic hydrogen as next generation fuel
- (c) Liquid ammonia is a better solvent for organic compounds. Why?
- 35.(a) What are the common characteristics of solvents?
- (b) Discuss the various methods for removal of permanent hardness
- (c) Compare the solubility products of hydroxides and sulphates of alkaline earth metals.

(15 X 2 = 30marks)

#### SYLLABUS FOR B.Sc. CHEMISTRY PROGRAMME

SEMESTER- II Foundation Course – II COURSE CODE- CH1221 Credit-2

Methodology and Perspectives of Sciences and General Informatics

36Hours

Lecture-Tutorial-Lab: 2-0-2 hours per week; eighteen 5-day weeks per semester. Contact hours per semester: 36 hrs lecture and 36 hrs related lab instruction.

#### Aim of the Course

The aim is to familiarize the student with the methodology and perspectives of Science and the importance of Science in the development of culture. The course introduces the student to the history of evolution of chemistry as a major branch of science. The course also focuses the various elementary aspects of research in chemistry. The contents emphasize the role of informatics in understanding Chemistry and to learn computer based application in analysis and presentation of experimental data. The course also focuses the various elementary aspects of analytical principles and safety measures in the laboratory.

#### Objective of the Course

On completion of the course the students will be able to understand how Science or in special Chemistry works. They will get a basic understanding to do self-directed experimentation work and research in chemistry under the guidance and supervision of a mentor. Analytical chemistry helps the students to understand about the experimental parts of the theory and the safety measures which could follow when doing experiments using chemicals.

#### Course out line

Module – 1 : Methods and Tools of Science & Experimentation in Science -----6 Hrs

Laws of science – Basis for scientific laws and factual truths -hypothesis – observations and proofs. Revision of scientific theories and laws. Importance of models, simulations and virtual testing in chemistry-Design of an experiment – experimentation - observation – data collection – types of data – examples-interpretation and deduction –repeatability and replication-units and dimensions,unit conversions . Documentation of experiments – record keeping

#### Module II – Evolution of Chemistry as a discipline of science -----6Hrs

Evolution of Chemistry - ancient speculations on the nature of matter, early form of chemistry-alchemy, Robert Boyle and the origins of modern chemistry in the latter 1600s - Antoine Lavoisier and the revolution in chemistry -Chemical atomism—background and thought of John Dalton. Atom models- Daltons, J. J. Thomson, Rutherford, Bohr model – Major contributions of Friedrich Wöhler, Mendeleev, Michael Faraday and Marie Skłodowska-Curie. Structure of chemical science: scope of chemical science, branches of chemistry. Basic ideas of interdisciplinary areas involving Chemistry

#### Module III Research in Chemistry

6 Hrs

Selecting a topic – hypothesis- Design of an experiment – observation – data collection – experimentation. Documentation of experiments – nature and types of data – typical example. interpretation and deduction – necessity of units and dimensions – Accuracy and precision, variables, correlation and causality, sampling, use of controls, experimental bias, analysis, results, discussion of results, models., statistical analysis of experimental data using computers, mean, mode, deviation, standard deviation. -Plotting graph, preparation of seminar papers, project. using computers.

Study of latest Nobel prize topics in chemistry ( only one in the year of study of S2 course from Nobel web site).

#### Module IV – Overview of Information Technology & Introduction to Cheminformatics 6 Hrs

Features of the modern personal computer and peripherals computer network and internet – Operating systems and softwares. Data information and knowledge. Knowledge management – Internet as a knowledge repository, Creating your cyber presence – open access. – Open active publishing models – Basic concepts of IPR, copy right and patents – plagiarism – Cybercrime. Introduction to use of IT in teaching and learning process – Educational softwares – INFLIBNET, NICNET, BRNET, NPTEL, VIRTUAL LABS OF MHRD academic services (elementary level only).

Basics of cheminformatics, applications of cheminformatics, storage & retrieval, file formats – MOL, SDF, CML,PDB formats, SYBYL Line Notation, SMILES of simple molecules like methane, benzene, cyclohexane. Structure drawing, spread sheet and chemistry related softwares. Molecular visualization tools. Chemical Databases.

#### Module V - Analytical Principles 6 hrs.

Inorganic qualitative analysis - Common ion effect - solubility product - precipitation of cations. Microscale analysis – Advantages

Quantitative Analysis - Theory of titration - acid-base, redox, precipitation and complexometric titrations. Theory of indicators - acid-base, redox, adsorption and metallochromic indicators.

Chromatography - classification of methods - Elementary study of adsorption chromatography Column and thin layer- partition chromatography-paper- ion exchange and gas chromatographic methods.



Gravimetric Analysis - Mechanism of precipitate formation - Factors affecting solubility of precipitates – co-precipitation and post precipitation - Effect of digestion - washing, drying and ignition of precipitates.

Introduction to lab safety-regulatory requirements-labels, material safety. Knowledge of hazard warning information and symbols. Explosive compounds(idea), potentially dangerous mixtures- Fire hazards(idea about flammable solvents, ignition sources used in laboratories, metal hydrides), Emergency procedures in chemical splashes to skin and eyes, burns and electric shock.

Reactive inorganic reactants and their toxicity (strong acids, bases, halogens, chromates). Hazards due to chemicals, toxic- solids, liquids, gases, and other harmful substances - carcinogenic substances.

#### References

1. T.F. Gieryn, Cultural boundaries of science Univ. Chicago Press 1999.
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4. Soti Sivendra Chanthra Contemporary Science Teaching,
5. Alexis & Mathews Leon, Fundamentals and Information Technology. Leon Vikas ISBN 08125907890. 6. Ramesh Bangia, 'Learning Computer Fundamentals, Khanna Book Publishers, ISBN 818752252b
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11. Haseen Taj Current Challenges in Education.
12. Radha Mohan Research Methods in Education.
13. R T Mishra Teaching of information Technology.
14. M Ravikumar Information Technology for Higher Education.
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21. <http://nptel.iitm.ac.in/>
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23. Day & Underwood "Quantitative analysis: laboratory manual"
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26. Vogel's text book of practical organic chemistry new edition
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University of Kerala  
Model Question Paper of B.Sc. Chemistry Programme  
2017 onwards  
Semester II Foundation Course 2 Course Code CH1221 Credit-2 Methodology and  
Perspectives of Sciences and General Informatics Time: Three Hours  
Maximum Marks: 80

Section- A

Each question carries one mark

Answer all Questions. Answer in one word / sentence. Each question carries 1 mark.

1. Who is the father of modern chemistry?
2. Define null hypothesis.
3. What is NPTEL?
4. What do you mean by plagiarism?
5. What are the contributions of Dmitri Mendeleev?
6. What are variables?
7. Define common ion effect
8. What are redox indicators?
9. Define accuracy
10. Write the name of two toxic chemicals used in chemistry laboratory.

Section B (short answer type)

(Answer any 8 questions from the following. Each answer carries 2 mark)

11. What is co-precipitation?
12. Define standard deviation.
13. Write a short note on a chemical which is skin irritant.
14. What is meant by data representation?
15. Name four chemistry related softwares?
16. Mention the toxicity of strong acids
17. What is a chemical database?
18. Explain basic concepts of IPR?
19. What are the features of modern personal computer?
20. What are acid base indicators ?
21. What is TLC?
22. Which are the factors affecting solubility of precipitates. Section C (Short essay type)

Answer any 8 from the following. Each question carries 4 marks.

23. What is meant by revision of scientific theories and laws?
24. Explain documentation of experiments.
25. Explain the applications of cheminformatics.
26. Explain copy right and patents.
27. Explain enquiry vs discovery approach?
28. Discuss about the carcinogenic chemicals used in the laboratory.
29. What is the scope of chemical science?
30. Write a short note on the theory of an acid base indicator
31. Explain the principle of gravimetric titration with an example.

Section D.

Answer any 2 from the following. Each question carries 15 marks

32. (a) Explain the various types of file formats. (5 marks)
- (b) Databases used in cheminformatics ? (5 marks)

- (c) Write the SMILES of Methane, Benzene and cyclohexane. (5 marks)
33. (a) Discuss about chemical safety.  
 (b) Discuss about the theory of titration.  
 (c) Write a note on the knowledge of hazard warning informations.
- 34.(a) Write a short note on the evolution of modern chemistry.  
 (b) Write a note on induction-deduction methods in knowledge transfer process.
- 35.(a) Explain the applications of common ion effect and solubility product in analysis of cations. (10 marks)  
 (b) Write a short note on method to avoid accidents in chemical laboratory. (5marks)

B.Sc. Chemistry Programme  
 Semester-3 Course-II Course Code – CH1341 Credit-3  
 Inorganic Chemistry- II 54 hrs

Lecture-Tutorial-Lab: 3-0-2 hours per week; eighteen 5-day weeks per semester. Contact hours per semester: 56 hrs lecture and 36 hrs related lab instruction.

#### Aim of the Course

The course is emphasized to provide fundamental to detailed knowledge in chemical bonding and compounds of non-transition elements. The course is designed to provide the students the fundamental knowledge of the nanomaterials. The course also describes about the various applications of nuclear chemistry.

Objectives: The objective of this course is to provide a necessary foundation for inorganic chemistry. This course build a thorough knowledge in chemical bonding and compounds of non-transition elements and gives an elementary idea about nanomaterials. It aims to lay a strong foundation in the area of nuclear chemistry.

#### Course out line

##### Module-1 Chemical Bonding –I

9hrs

Concept of resonance, formal charges. VSEPR theory and its applications - structure of molecules with bond pairs only, molecules with both bond pairs and lone pairs . -Valence bond theory-Conditions for overlapping-Types of overlapping (positive, negative and Zero overlapping), - hybridization - methane, ethylene, benzene, acetylene, allenes,  $sp^3d$  and  $sp^3d^2$ – Limitations of VBT

MO theory, LCAO, homonuclear diatomic molecules-  $C_2$ ,  $B_2$ ,  $N_2$ ,  $O_2$  and ions like  $O_2^{+}$ - heteronuclear diatomic molecules (HF, NO, and CO) – Bond order - comparison of VB and MO theories

##### Module II : Chemical Bonding –II

9hrs

Ionic bond-ionic lattice energy of ionic compounds- Bond-Lande equation, BornHaber cycle, solvation energy and solubility of ionic solids-covalent character of ionic bond, Fajan's rules

Polarity of Covalent bond- dipole moment- percentage ionic character- dipole moment and molecular structure

Metallic bonding- free energy theory, VB theory and band theory (Qualitative treatment only)- Secondary forces – hydrogen bond, inter and intramolecular hydrogen bond, intermolecular interaction –

ion –dipole van der Waals forces such as dispersion forces, dipole-dipole, ion-induced dipole, dipole-induced dipole

Module III Compounds of non-transition elements I (9 hrs)

Manufacture and uses of the following Glass – different types of glasses, Silicates, Zeolites and Silicones. Borax - boron hydrides, boron nitrides, borazole and carboranes. Oxides and oxyacids of phosphorus. Refractory carbides, nitrides, salt-like carbides, borides, and silicides.

Module IV Compounds of non-transition elements II (9 hrs)

Oxides and oxyacids of halogens (structure only) – Inter halogen compounds and pseudo halogens – Compounds of noble gases (Xenon and Radon)– Uses of noble gases. Inorganic polymers Phosphorus, boron and silicon based polymers – Structure and industrial applications.

Module V: Nuclear Chemistry (9hrs)

Natural radioactivity, modes of decay, decay constant(Derivation not expected), half life, average life, Disintegration series. Geiger –Nuttal rule, artificial transmutation and artificial radioactivity- nuclear stability, n/p ratio, packing fraction, mass defect and binding energy, Nuclear models –Shell model and liquid drop model. nuclear fission-atom bomb and nuclear fusion-hydrogen bomb-applications of radioactivity- <sup>14</sup>C dating, rock dating neutron activation analysis and isotope as tracers. Study of reaction mechanism (ester hydrolysis)-application of radioactive isotopes in medicine - Radio diagnosis and radiotherapy. (Including numerical problems)

Module VI : Chemistry of Nanomaterials (9hrs)

Evolution of Nanoscience – Historical aspects- Preparations containing nano gold in traditional medicine. Lycopodium cup- Faraday's divided metal etc. Nanosystems in nature. Preparation of nanoparticles: Top-down approaches and Bottom to top approach Sol-gel synthesis, Colloidal precipitation, Co-precipitation, Combustion technique, Sonochemistry, Hydrothermal technique, High energy ball milling etc. Carbon nanotubes and fullerenes. Properties of nanoparticles: optical, magnetic, mechanical, thermal and catalytic properties with examples.

Reference:

1. "Basic Inorganic Chemistry" ; F. A. Cotton, G. Wilkinson and P. L. Gaus, Willey
2. "Concise Inorganic Chemistry" : J. D. Lee, ELBS
3. "Theoretical Inorganic Chemistry" : M. C. Day and Selbin
4. "Inorganic Chemistry- Principles and Structure and Reactivity" : J. E. Huheey
5. "Inorganic Chemistry" : Shriver and Atkins
6. "Coordination Chemistry" :Bosolo and Johnson
7. "Coordination Chemistry" : S. F. A. Kettle
8. "Inorganic Chemistry" : J. E. Hueey
9. Essentials of Nuclear Chemistry : H S Arniker
10. Puri, Sharma and Kalia "Inorganic Chemistry"
11. Madan "Inorganic Chemistry".
- 12.T.F.Gieryn, Cultural boundaries of science Univ. Chicago Press 1999.
- 13.H.J. Arnika, Essentials of Nuclear Chemistry, 4th Edition, New Age International (P) Ltd., New Delhi, 1995 (Reprint 2005).
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16. "Nano, The Essentials", T. Pradeep, Mc Graw- Hill Education

Model Question Paper of B.Sc. Chemistry Programme  
2017 admissions onwards  
Semester -III Core Course-II Course Code – CH1341 Credit-  
3 INORGANIC CHEMISTRY II Time: Three Hours  
Maximum Marks: 80

SECTION A

(Answer all questions. Each question carries 1 mark)

1. What is the bond order of  $O_2^+$ .
2. What is fullerenes?
3. What are nano sensors?
4. Name the hydrogen bonding in salicylaldehyde.
5. What is inorganic benzene?
6. Write an example for inter halogen compound.
7. Example for phosphorus based polymer.
8. Name a naturally occurring radioactive element.
9. Write an example of carboranes?
10. What is zeolite.

SECTION B

(Answer any 8 questions. Each question carries 2 Marks)

11. Compare the properties of Borazole with benzene
12. Explain the method of preparation of gold nano particles
13. Applications of nano particles in medicine and electronics
14. Write a note on Fajans rule
15. Calculate the bond order of  $N_2$ ,  $B_2$ ,  $C_2$  and  $O_2$
16. What are the limitations of VBT?
17. Explain the structure of diborane
18. What is lattice energy?
19. State Geiger –Nuttal rule.
20. What are carboranes ?
21. Write a note on Born-Haber cycle
22. What is nuclear fission ?

### SECTION C

(Answer any 6 questions. Each question carries 4 Marks)

23. Draw the MO diagram for NO and C<sub>2</sub> molecule
24. Give a comparative account of VB and MO theories using relevant examples.
25. What is meant by dipole moment? How it is helpful in explaining the structure of molecules.
26. Write a note on the preparation of nano particles using sol-gel method.
27. Explain the optical, magnetic, thermal and catalytic properties of nanoparticles with examples.
28. Write the hybridisation and structures of Xenon compounds.
29. Explain artificial transmutation with example.
30. Explain mass defect.
31. Write a note on the manufacture of glasses.

### SECTION D

(Answer any 2 questions. Each question carries 15 Marks)

- 32.(a) Explain VSEPR theory with example (5 marks)
  - (b) Write a note on solvation energy and solubility of ionic solids (5 marks)
  - (c) Write a note on secondary bond forces (5 marks)
33. (a) Explain the optical, magnetic, thermal and catalytic properties of nanoparticles with examples (b) Write a note on radio carbon dating.
34. (a) Write a note on the manufacture of glass.
  - (b) Explain the preparation and bonding of noble gases.
35. (a) Write a note on carbon nanotubes and fullerenes
  - (b) Explain inorganic polymers
  - (c) Write a note on band theory

SEMESTER – IV (Core Course – 3) Credit – 3 Course Code – CH1441

Organic chemistry Paper – I Total : 54 hours

Lecture - Tutorial – Lab: 3-0-2

Aim of the Course: The syllabus includes introduction to classification, nomenclature, mechanism of reactions, aromaticity and the chemistry of aliphatic and aromatic substituted compounds. The course also describes the stereochemistry of organic compounds.

Objective of the Course: It imparts the behaviour of aliphatic and aromatic compounds and introduces the concept of reaction mechanism. Make the students to understand the mechanism of reactions of organic compounds, stereochemical aspects, photochemical reactions and aromaticity.

#### Module I: Introduction to organic chemistry (3 hours)

Uniqueness of carbon – classification of organic compounds – Functional groups (mention only) Review of basic rules of IUPAC nomenclature and IUPAC naming of organic compounds.

Types of reagents: Electrophiles and Nucleophiles.

Types and subtypes of organic reactions: Substitution, addition. Elimination and rearrangement (definition and simple examples only).

#### Module II :Introduction to organic reaction mechanism: (9 hours)

Definition of reaction mechanism.

Drawing of electron movements with arrows – curved arrow notation. Half headed and double headed arrows. Nature of bond fissions :Homolysis and heterolysis.

Electron displacement effects: Inductive effect, electromeric effect, mesomeric effect, resonance, hyperconjugative and steric effects.

Acidity and basicity of organic compounds based on inductive and resonance with reference to acid characters of alcohols, phenols and carboxylic acids and basic character of aliphatic and aromatic amines.

Applications of hyperconjugative effect – stability of alkenes, alkylbenzenes, free radicals and carbocations.

Reaction intermediates: Carbocations, carbanions, free radicals and carbenes (definition, hybridization, structure, classification, formation, stability and important reactions) – rearrangement of carbocations – nitrenes(mention only).

Introduction to pericyclic reaction – Electrocyclic, cycloaddition and sigmatropic reactions.

#### Module III : Reaction Mechanism II (9 hours)

Aliphatic nucleophilic substitutions, mechanism of SN1 and SN2 reactions – Effect of structure, substrate, solvent, nucleophile and leaving groups. Stereochemistry – Walden Inversion.

Elimination reaction: Hoffmann and Saytzeff rule – cis and trans eliminations – mechanisms of E1 and E2 reactions. Substitution vs Elimination.

Addition reactions – mechanism of addition of bromine and hydrogen halides to double bonds – Markownikoff's rule and peroxide effect. Cis-hydroxylation.

Elimination – Addition mechanism – Benzyne intermediate.

Methods of determination of reaction mechanism – product analysis, intermediates, isotopic effect, kinetic and stereochemical studies.

#### Module IV: Stereochemistry I (6 hours)

Representation of organic molecules: Fischer, Flying wedge, Sawhorse and Newman projection formulae.

Conformational isomerism – conformation – Dihedral angle – Torsional strain – conformational analysis of ethane and n-butane including energy diagrams – Baeyer's strain theory – Sachse-Mohr theory of strainless rings – conformation of cyclohexane (chair, boat and skew boat forms) – axial and equatorial bonds – ring flipping – conformers of mono and dialkyl substituted cyclohexanes.

## Module V: Stereochemistry II (9 hours)

Optical Isomerism : Chirality and elements of symmetry – DL notation – Enantiomers – optical isomerism in glyceraldehydes, lactic acid and tartaric acid – Diastereoisomers – mesocompounds – Cahn-Ingold-Prelog rules – R-S notations for optical isomers with one and two asymmetric carbon atoms.- erythro and threo representations. Racemic mixture – resolution – methods of resolution.

Enantiomeric excess – Introduction to asymmetric synthesis

Optical activity in compounds not containing symmetric carbon atoms – biphenyls and allenes.

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, dipolemoment, dehydration and cyclisation.

## Module VI: Organic photochemical reactions and Dyes (9 hours)

Introduction – photochemical vs thermal reactions

Photochemical reactions of olefins: Photosensitization and photodimerisation

Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (Benzophenone to benzopinacol)

Dyes – Theory of colour and constitution – classification according to structure and method of application. Preparation and uses of methyl orange, congo red, malachite green, crystal violet, phenolphthalein, fluorescein, alizarin and indigo.

## Module VII :Arenes and Aromaticity (9hours)

Heat of hydrogenation and heat of combustion of benzene – structure of benzene, naphthalene and anthracene – Concept of aromaticity – Huckel's rule – Application to benzenoid and nonbenzenoid compounds.

Reactions – Mechanism of electrophilic substitution in benzene – halogenation, nitration, sulphonation and Friedel Craft's alkylation and acylation – energy profile diagram.

Ring activating and deactivating groups with examples – orientation effect in monosubstituted benzene - –OH, -NH<sub>2</sub>, NO<sub>2</sub>, -CH<sub>3</sub> and halogens.

Aromatic nucleophilic substitution – bimolecular displacement mechanism – Elimination-Addition mechanism. Reactivity and orientation in Aromatic Nucleophilic substitution.

Reactivity of naphthalene towards alkylation, nitration and sulphonation. Carcinogenic polynucleararenes

## References

- (1) A.Bahl and B.S.Bahl, Advanced Organic Chemistry, S.Chand & Company, New Delhi.
- (2) L.G.Wade Jr, Organic Chemistry, Pearson Education, New Delhi.
- (3) K.S.Tewari, N.K.Vishnoi and S.N.Mehrotra, A textbook of Organic Chemistry, Vikas Publishing House (Pvt) Ltd., New Delhi..
- (4) S.C.Sharma and M.K.Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi.. (5)P.L.Soni, Organic Chemistry
- (6) D.Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications, New Age International Publishers, New Delhi.
- (7) P.S.Kalsi, Organic Reactions, Stereochemistry, and Mechanism, New Age International Publishers, New Delhi.



- (8) R.T.Morrison, R.N.Boyd. Organic Chemistry, Pearson Education, New Delhi.
- (9) P.Y.Bruice, Essential Organic Chemistry, Pearson Education, New Delhi.
- (10) Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, Pearson Education, New Delhi.
- (11) J.Clayden, N.Greeves and S.Warren, Organic Chemistry, Oxford University Press, New York.
- (12) G.M. Louden, Organic Chemistry, Oxford University Press, New York.
- (13) E.L.Eliel, Stereochemistry of Carbon compounds, Tata McGraw Hill Publishing House, New Delhi.
- (14) Jagadamba Singh and Jaya Singh, Photochemistry and Pericyclic reactions, New Age International, New Delhi.
- (15) J.March, Advanced Organic Chemistry, John Wiley & Sons., NY.
- (16) S.M.Mukerji and S.P.Singh, Reaction Mechanism in Organic Chemistry, McMillan Publishers.
- (17) I L Finar, "Organic Chemistry" Vol – 1, 5<sup>th</sup> Edition, Pearson Education, NewDelhi

University of Kerala  
 Model Question Paper of BSc Chemistry Programme  
 2017 Admission onwards  
 SEMESTER IV Core Course III Course Code CH1441Credit-3  
 ORGANIC CHEMISTRY I

Time:3hours

Max.Marks : 80

SECTION – A

(Answer all questions. Answer in one word to maximum two sentences. Each question carries one mark)

1. What is the product formed when a bond undergoes homolytic fission?
2. Give one example for each (i) substitution reaction and (ii) elimination reaction.
3. Write an example for electrocyclic reaction.
4. Name two reagents used for cis-hydroxylation.
5. What the products obtained when naphthalene undergoes sulphonation at different temperatures?
6. Identify the orienting effect of the following functional groups –CH<sub>3</sub>, -NO<sub>2</sub>, -CHO and –OH.
7. What are chromophores?
8. What are conformers?
9. What is geometrical isomerism?
10. Explain the term chirality. (1 X 10 =10 Marks)

SECTION - B

(Short answer type. Answer any 8 questions from the following. Each question carries two marks.)

11. What are electrophiles and nucleophiles? Give examples
12. Write the structure of the following compounds (i) 3,3,4-trimethyl-4-heptene (ii) 2-ethyl-3-methyl hexanal.
13. Phenol is acidic while ethanol is not. Why?
14. Arrange the following in the decreasing order of stability. Justify your answer.  
 $(\text{CH}_3)_2\text{CH}^+$ ,  $\text{CH}_3^+$ ,  $(\text{C}_6\text{H}_5)_2\text{CH}^+$ ,  $\text{C}_6\text{H}_5\text{CH}_2^+$
15. Give an example and state Hofmann rule.
16. What is Walden Inversion?
17. What is Kharasch effect? Illustrate with an example.
18. When toluene is nitrated the major products are ortho and para substituted products. Why?

19. Define Huckel's rule.
20. Explain photosensitization with an example.
21. What is enantiomeric excess?
22. Explain with examples the importance of dipole moment measurements in distinguishing geometrical isomerism.

(2 X 8 = 16 Marks)

#### SECTION - C

(Short essay type. Answer any 6 questions from the following. Each question carries four marks.)

23. What is inductive effect? How is it affect the acidity and basicity of organic acids and bases?
24. Explain the mechanism of E1 and E2 eliminations.
25. o-chloro toluene when treated with sodamide in liquid ammonia gives o-toluidine and m-toluidine. Explain this observation with relevant mechanism.
26. Explain Norrish I and Norrish II reactions.
27. Determine the R & S notations of the asymmetric carbon atoms in (+)-tartaric and (-) tartaric acid
28. Explain the conformational analysis of n-butane.
29. Give a brief account on optical activity due to restricted rotation.
30. Explain any two methods of determination of reaction mechanism.
31. What are non-benzenoid aromatics compounds. Explain their aromaticity with examples

(4 X 6 =

#### 24marks) SECTION – D

(Answer any 2 question. Each question carries 15 marks)

32. (a) Explain SN1 and SN2 mechanisms.  
(b) Write the influence of structure of the substrate and polarity of the solvent on nucleophilic substitution reactions. (c) Explain Baeyer's strain theory.
33. (a) Explain the mechanism of (i) nitration (ii) halogenation of benzene.  
(b) Discuss the orientation of influence of -NO<sub>2</sub> and -OH group in aromatic electrophilic Substitution.  
(c) Discuss the classification of dyes on the basis of structure.
34. (a) What is resolution? Explain different methods of resolution.  
(b) What are carbenes? How are they generated? Comment on the structure of carbene.  
(c) Draw conformers of dimethyl cyclohexane and discuss their comparative stability.
35. (a) Write the synthesis and uses of the following dyes (i) Malachite green (ii) Methyl Orange.  
(b) Explain the geometrical isomerism of maleic and fumaric acid.  
(c) Explain the elimination-addition mechanism in halo benzens.

(15 X 2 = 30marks)

B.Sc. Chemistry Programme  
Semester – V (Course V)  
Course Code – CH1541 Credit - 3  
Physical Chemistry – I 54 hours

Aim of the course: This course is an introduction to different states of matter and provides a firm foundation for understanding the physical principles that govern chemical systems. The course also describes the principles of chemical thermodynamics and group theory.

Objectives: Students, upon completion of this course, will gain exposure and practice in the areas of physical chemistry which include gas and liquid properties, thermodynamics, and group theory. The laws of thermodynamics form the appropriate organizational tool to understand the chemistry of bulk systems.

Module I – Gaseous state (9 hrs)

Ideal gas equation, Behaviour of real gases, Deviation from ideal behaviour, Compressibility factor, Boyle temperature - van der Waal's equation of state – derivation and importance, Virial equation of state.

Critical phenomena: Isotherms of CO<sub>2</sub>, continuity of states, Critical constants and their experimental determination, relation between critical constants and van der Waals constants.

Types of molecular velocities and their inter relations. Maxwell Boltzmann distribution of molecular velocities, Statement of equation and explanation (No derivation), Effect of temperature on distribution of molecular velocities - Derivation of most probable and average velocities from the equation.

Collision properties. Collision diameter, Collision number, Collision frequency and mean free path. Relation between collision parameters and viscosity and thermal conductivity of gases (no derivation).

Module II – Solid state (9 hrs)

Isotropy and anisotropy, Space lattice and unit cell, Elements of symmetry of crystals, Bravais lattices, Crystal systems, Laws of rational indices, Miller indices, Representation of lattice planes of cubic crystals, Determination of Avogadro number from crystallographic data, X-ray diffraction studies of crystals, Bragg's equation – derivation and applications, Rotating crystal and powder method, Structure of NaCl and KCl Rutile, Zinc blend, Wurtzite - Imperfections in crystals, point defects – Schottky and Frenkel defects, Non-stoichiometric defects – Line defects – edge dislocation – screw dislocation.

Module III – Liquid state and Dilute solutions (9 hrs)

Vacancy theory of liquid state : Properties of liquids: Surface tension and its measurement by capillary rise and stalagmometer method, factors affecting Surface tension, Viscosity, Poiseuille's equation, Determination of viscosity by Ostwald's viscometer, Refractive index and its determination by Abbe refractometer.

Dilute solutions: Molarity, Molality, Normality and Mole fraction. Colligative properties, Thermodynamic derivation of  $\Delta T_b = K_b \times m$  and  $\Delta T_f = K_f \times m$ , Osmotic pressure, van't Hoff equation and molecular mass, Isotonic solutions, Reverse osmosis - Determination of molecular mass of solutes by Beckmann's method, Rast's method and cooling curve method. Abnormal molecular mass, van't Hoff factor, Determination of degree of dissociation and association.

Module IV – Thermodynamics I (9hrs)

Types of Processes, Zeroth law of thermodynamics Definition of internal energy and enthalpy. Heat capacities at constant volume (C<sub>v</sub>) and at constant pressure (C<sub>p</sub>), relationship between C<sub>p</sub> and C<sub>v</sub>. Mathematical statement of first law. Reversible process and maximum work. Calculation of work, heat, internal energy change and enthalpy change for the expansion of an ideal gas under reversible isothermal and adiabatic condition. The Joule-Thomson effect – derivation of the expression for Joule-Thomson coefficient. Sign and magnitude of Joule-Thomson coefficient, inversion temperature.

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

Module V – Thermodynamics II (9 hrs)

Need for II<sup>nd</sup> law of thermodynamics. Different statements of II<sup>nd</sup> law, Thermodynamic scale of temperature. Carnot cycle and its efficiency, Carnot theorem. Concept of entropy- Definition and physical significance. Entropy as a function of volume and temperature, Entropy as a function of pressure and temperature. Entropy as a criterion of spontaneity and equilibrium. Gibbs and Helmholtz free energies and their significances - criteria of equilibrium and spontaneity.

Gibbs-Helmholtz equation, dependence of Gibbs free energy changes on temperature, volume and pressure. Maxwell's relations. Partial molar quantities. Chemical potential-Gibbs-Duhem equation. Clapeyron – Clausius equation. Concept of fugacity, determination of fugacity by graphical method.

#### Module VI – Group theory – 9 hours

Group theory: Elements of symmetry – Proper and improper axis of symmetry, plane of symmetry, centre of symmetry and identity element. Combination of symmetry elements, Determination of point groups of simple molecules like Acetylene,  $H_2O$ ,  $NH_3$ ,  $BF_3$ ,  $[Ni(CN)_4]^{2-}$  and  $C_6H_6$ . Symmetry operations. Order of a group. Combination of symmetry operations. Group theoretical rules. Construction of Group multiplication table of  $C_{2v}$ . (5 hours)

Liquid crystals:

Origin of liquid crystals, mesogens self-organisation, Types – smectic, nematic and cholesteric liquid crystals, characterization of liquid crystals, Swarm theory of liquid crystals, uses of liquid crystals, characterization of LC materials by DSC, PLM and x-ray. (4 hours)

(At least 100 problems are to be worked out from all units together. 30% of the questions for Examination shall contain problems.) References

1. P W Atkins, "Physical Chemistry", Oxford University Press
2. R J Silby and R A Alberty, "Physical Chemistry", John Wiley & Sons
3. G W Castellan, "Physical Chemistry", Narosa Publishing House
4. F Daniels and R A Alberty, "Physical Chemistry", Wiley Eastern
5. E A Moelwyn Hughes, "Physical Chemistry", Pergamon Press
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7. R. Stephen Berry, Stuart A. Rice, John Ross, "Physical Chemistry, 2nd edition, Oxford".
8. Gurdeep Raj, "Advanced Physical Chemistry", Goel Publishing House
9. S Glasstone, "Thermodynamics for Chemists", Affiliated East West Publishers
10. L V Azaroff, "Introduction to Solids", McGraw Hill
11. N B Hannay, "Solid State Chemistry", Prentice Hall
12. Anthony R West, "Solid State Chemistry and its Applications", Wiley Eastern
13. V Ramakrishnan and M S Gopinathan, "Group Theory in Chemistry", Vishal Publishing Co.
14. A. Salahuddin Kunju and G. Krishnan "Group Theory and its Applications in Chemistry" 15. A.S.Negi and S.C.Anand, A text book of Physical Chemistry, New Age International publishers.

University of Kerala  
Model Question Paper of B.Sc. Chemistry Programme  
(2017 admissions onwards)

Semester V- Core Course-5 Course Code 1541 Credit-4  
Physical Chemistry –I

Time: 3 Hrs

Total marks: 80

Section A. Answer all the questions. Each question carries 1 mark

1. Write down the van der Waal's equation for n moles of a gas.
2. In which type of liquid crystals, the colour of the material is sensitive to temperature changes?
3. What are isotonic solutions?
4. Write down the conditions at which real gases tend to approach ideal behaviour.
5. Define the term fluidity.
6. What is inversion temperature?
7. Write down the efficiency of Carnot engine.
8. The average speed of a certain gas at 27°C is 400ms<sup>-1</sup>. Calculate the temperature at which the speed will be 800ms<sup>-1</sup>.
9. What is meant by unit cell in crystallography?
10. What is the physical significance of entropy? (1 x 10 = 10 marks)

Section B

Each question carries 2 marks (Short answer). Answer any 8 questions

11. What are colligative properties?
12. Write the point group to which NH<sub>3</sub> belongs and mention the symmetry elements present in NH<sub>3</sub>.
13. Explain van't Hoff factor
14. Explain first law of thermodynamics.
15. Derive the expression for Joule Thomson coefficient
16. Explain any two statements of second law of thermodynamics.
17. Maximum work is obtained from a reversible process. Substantiate.
18. What are the proper and improper axes of symmetry?
19. Draw the group multiplication table of C<sub>2v</sub> point group
20. Define the terms collision frequency and collision number.
21. Explain virial equation of state.
22. Explain elements of symmetry of crystals. (2×8 = 16)

Section C

Each question carry 4 marks (Short essay) Answer any 6 questions

23. Derive root most probable velocity and average velocity from Maxwell- Boltzmann equation.
24. An aqueous solution containing 0.25 g of a solute dissolved in 20 g of water froze at - 0.42 °C. Calculate the molar mass of the solute. Molar heat of fusion of ice at 0°C is 6.025 KJ and R = 8.314 JK<sup>-1</sup>mol<sup>-1</sup>
25. Deduce the relationship between Cp and Cv by thermodynamics.
26. Explain different types of semi-conductors and their uses.
27. What is the law of corresponding states? How is it derived from van der Waals equation.
28. Explain Gibbs - Helmholtz equation and its significance
29. What is chemical potential and derive Gibbs Duhem equation?

30. Explain Hess's law and its applications  
31. Derive the relation between depression of freezing point and lowering of vapour pressure.  
(4 x 6 = 24 marks)

Section D

Each question carries 15 marks (essay), Answer any two questions

32. a) Derive Bragg's equation. (5 marks)  
b) The edge length of the unit cell of NaCl crystal lattice is 564 pm by X-ray diffraction. Compute the interionic distance between sodium and chloride ions. (5 marks)  
c) Explain point defects in a crystal. (5 marks)
33. a) What is meant by reversible process? Derive an expression for work done in the reversible isothermal expansion of an ideal gas. (5 marks) b) Calculate the work done in expanding one mole of an ideal gas from a volume of 2 to 20 dm<sup>3</sup> at 27 °C (5 marks) c) Derive the relation between Cp and Cv. (5 marks)
34. a) Calculate Tc, Pc and Vc for C<sub>2</sub>H<sub>2</sub>. Given a = 4.390 atm litre mol<sup>-2</sup>, b=0.05136 litre mol<sup>-1</sup>. (5 marks)  
b) Do all gases obey gas laws? Discuss some experimental results to explain deviation and point out the causes which accounts for this behaviour. (10 marks)
35. a) Derive thermodynamically the relation between the elevation of boiling point of a solvent and molal concentration of an electrolyte dissolved in the solvent. (5 marks) b) The surface tension of water at 293 K is 72.75 dyne cm<sup>-1</sup>. How high will a column of water rise in a capillary tube with a radius of 0.005 cm. (5 marks) c) Illustrate the operation improper rotation. (5 marks)

(15x2=30)

B.Sc. Chemistry Programme  
Semester 5 Course – V Course Code –CH1542 Credit 4  
Inorganic Chemistry – III (72 hrs)  
Lecture-Tutorial-Lab: 4-0-3 hours per week; eighteen 5-day weeks per semester. Contact hours per semester: 72 hrs lecture and 54 hrs related lab instruction.

Aim of the course: The main objective of this course is to help students to learn the important multidisciplinary areas of bioinorganic chemistry and organometallic chemistry. The main theme of this course is the importance of fundamental concepts needed to understand transition metal chemistry, including transition meta I ions in biological systems and about the inner transition elements and the principles of coordination chemistry. The course also describes about the general principles of isolation and purification of elements and instrumental methods of analysis.

Objectives: Students, upon completion of this course, will gain exposure and practice in the areas of inorganic chemistry which include coordination chemistry, transition and inner transition elements. Students will have a thorough understanding of the classification of several organometallic reactions and will be able to identify the role of organometallic compounds in organic synthesis. Instrumental methods of analysis and general principles of isolation of elements help the students to understand about the experimental techniques used in chemistry and how the elements are isolated from their ores.

Course out line

#### Module I Transition and inner transition elements (18 hrs)

(a) Transition elements : Electronic configuration and general characteristics – oxidation state, ionization enthalpy (variation of I,II and III ionization enthalpy across 3d series), enthalpy of atomisation, melting and boiling point, density, variation of std. electrode potentials ( $E_{M^{2+}/M}^{\circ}$  &  $E_{M^{3+}/M^{2+}}^{\circ}$ ), stability of higher oxidation states, colour, magnetic property, catalytic property and formation of complexes. Comparison of 3d, 4d and 5d transition series –Preparation, properties and uses of  $K_2Cr_2O_7$ ,  $KMnO_4$  and  $TiCl_4$ . Important application of transition metals

(b) Lanthanides and actinides : Lanthanides - electronic configuration and general properties, reactions – Occurrence and isolation of lanthanides from monazite – Lanthanide contraction – consequences of lanthanide contraction– Magnetic properties and complexation behaviour.

Actinides – Oxidation states, ionic radii, colour, complex formation, actinide contraction, comparison with lanthanides.

#### Module II Coordination Chemistry (18 hrs)

Nomenclature ( latest version) – ligands and their classifications. EAN rule – Chelates – Stability of complexes – Factors affecting stability of complexes – Isomerism – Structural and stereoisomerism – Geometrical and optical isomerism – Bonding in complexes – V.B. Theory, CFT applied to Oh, Td and SPcomplexes. factors affecting crystal field, — Spectrochemical series – CFSE, Magnetic properties and colour of metal complexes .Effect of crystal field splitting –Jahn -Teller effect, Tetragonal distortion of an octahedral complex- — Application of coordination compounds in quantitative and qualitative analysis. Reactions of metal complexes-labile & inert complexes, ligand substitution reactions-  $S_N1$  &  $S_N2$  reactions-

### Module III Organometallic Compounds(12hrs)

Organometallic Compounds : Definition – Nomenclature and classification – sigma complex – Pi complex – those containing both sigma and Pi bonds – 18 electron rule – Metal carbonyls – mononuclear and polynuclear (give examples of carbonyls of Fe, Co, Ni ) – preparation and properties of carbonyls(Fe, Ni, Mn, Cr) Vibrational frequency of CO bond in metal carbonyls – Bonding in organometallic compounds like ferrocene, dibenzene chromium, Ziese's salt (Without MOT)– Dinitrogen complexes – Application of organometallic compounds.

### Module IV Bioinorganic Chemistry

6 hrs

Bioinorganic Chemistry: Role of metal ions in biological systems – Biochemistry of iron, haemoglobin and myoglobin (elementary idea of the structure and mechanisms of their actions). Electron transport proteins: Cytochromes, Fe- Sulphur proteins, Storage and transport of iron .Photosynthesis – Sodium-Potassium pump - Biochemistry of magnesium and calcium (brief study only)

### Module V General Principles of Isolation of Elements

9hrs

Methods of concentration of an ore-Gravity separation, Froth floatation, Magnetic separation, Leaching, electrostatic separation, Automated ore sorting and dewatering,Preliminary processes - calcination and roasting. Methods of preparing metal from concentrated ore- Electro metallurgy- Metallurgy of Aluminium, Sodium-Pyro Metallurgy- - Metallurgy of Iron, Zinc, Aluminothermy, Auto reduction-Hydro Metallurgy- Metallurgy of Silver, Gold

Purification of crude metal- Distillation, Liquefaction, Zone refining, Vapour phase refining (Mond's process and van Arkel processes), Electro refining, Chromatography technique

### Module VI: Instrumental Methods of Analysis

9hrs

Atomic absorption spectroscopy- flame emission spectroscopy- applications – colorimetry- spectrophotometry- laws of spectrophotometry- Beer- Lambert's law- applications of spectrophotometry- thermal methods- introduction to TG, DTA and DSC- instrumentations and applications. Tools for measuring nanostructures: XRD, Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy(STM), Scanning Electron Microscopy(SEM), Transmission Electron Microscopy(TEM) References:

1. Advanced Inorganic Chemistry : Cotton and Wilkinson
2. Inorganic Chemistry : J.E. Huheey
3. Inorganic Chemistry : Shriver and Atkins
4. Concise inorganic Chemistry :J.D.Lee
5. Coordination Chemistry :Bosolo and Johnson
6. Coordination Chemistry : S. F. A. Kettle
7. Bio inorganic Chemistry : M.N. Hughes
8. "Fundamentals of Inorganic Chemistry" : E. S. Gilreath
9. "Instrumental Methods of Analysis" : Willard, Merritt
10. A. K. Srivastava and P. C. Jain, "Chemical Analysis"
11. Puri, Sharma and Kalia "Inorganic Chemistry"



University of Kerala  
Model Question Paper of B.Sc. Chemistry Programme  
2017 admissions onwards  
Semester V Course VI Course Code CH1542 Credit-4  
Inorganic Chemistry III

Time: Three Hours

Maximum Marks : 80

Section A

Answer all questions, each question carries 1 mark (answer in a word\sentence)

1. Which is more basic;  $\text{La}(\text{OH})_3$  or  $\text{Lu}(\text{OH})_3$ ?
2. Give the general outer electronic configuration of a transition element.
3. Which is the catalyst used in the oxidation of  $\text{SO}_2$  to  $\text{SO}_3$  in contact process?
4. Name the element obtained by the bombardment of  $^{238}\text{U}$  with an  $\alpha$  - particle.
5. What is the coordination number of Ag in  $[\text{Ag}(\text{CN})_2]$  ?
6. Give the IUPAC name of  $\text{Na}_3[\text{Co}(\text{CO}_3)_3]$  7 What is the unit of magnetic moment?
8. Give the example for a tridentate ligand.
9. Write the structure of ferrocene.
10. Give the formula of a metal carbonyl which does not obey 18-electron rule. (1 x 10 = 10)

Section B

Answer any 8 questions, each question carries 2 marks (short answer questions)

11. Explain zone refining.
  12. Name the metal ion, other than magnesium, involved in photosynthesis.
  13. Give an example of phosphorus based polymer.
  14. What is 'inorganic graphite'?
  15. What is the oxidation number of P in  $\text{H}_3\text{PO}_4$ ?
  16. Give the formula of a methanide.
  17. Transition metals are less reactive than the alkali and alkaline earth metals - Justify.
  18. Which is more stable:  $\text{Cu}^{2+}$  or  $\text{Cu}^+$  in aqueous solution. ? Substantiate your answer.
  19. Which has got greater tendency to form complexes; lanthanides or actinides ? Give reasons. 20. Write the difference between calcinations and roasting 21. What is an ambidentate ligand ? Give example.
  22. Explain geometrical isomerism in metal complexes with suitable example.
- ( 2x8=16)

Section C

Answer any 6 questions, each question carries 4 marks (short essay type)

23. What is Ziese's salt ? Give its structure.
24. State and explain 18-electron rule.
25. How haemoglobin differ from myoglobin.
26. What are carboranes ?
27. Purification of crude metals by Mond's process and van Arkel processes
28. What happens when orthophosphoric acid is heated ?
29. What is lanthanide contraction ? Explain its consequences .
30. What are the factors that affect stability of metal complexes ? 31. Give an account of the applications of coordination compounds in quantitative and qualitative analysis.

## Section D

(Answer any 2 questions, Each question carries 15 marks) (essay type)

- 32.a. Describe the ion exchange method for the separation of lanthanides from monazite. (5 marks)
- b. Describe the splitting of d-orbitals in tetrahedral and octahedral fields according to crystal field theory. (5 marks)
- c. Comment on the magnetic properties of lanthanides. (5 marks)
- 33.a. Give an account of the preparation, properties, structure and bonding of noble gas compounds. (10 marks)
- b. Discuss the nature of bonding in metal carbonyls. (5 marks)
- 34.a. How silicones are prepared? Discuss their structure and uses.
- b. Give an account of sodium-potassium pump in biological systems.
- c. Explain the principle of TG with example.
- 35.a. Starting from pyrolusite, how  $\text{KMnO}_4$  is prepared?
- b. Explain the principle and working of AFM.

## Semester- V Core Course -VII Credit-4 Course Code – CH1543

### Organic Chemistry- II

72 Hrs Lecture- Tutorial- Lab : 4-0-2

**Aim of the Course:** The course deals with organic compounds like alcohols, aldehydes, ketones, ethers, acids and their properties. The course also describes the principles of spectroscopy and spectral applications to organic molecules and also introduces the fundamentals of green chemistry and supramolecular chemistry.

**Objective of the Course:** The students will get an interesting idea about the preparation and properties, mechanism of reactions of many organic conversions and of organic compounds. They will also get sufficient knowledge to interpret spectrum of organic compounds and the novel areas of organic chemistry – the supramolecular and green chemistry.

### Organic chemistry Paper II

#### Module I: Alcohols, Phenols and Ethers (12 hours)

**Alcohols:** Preparation: From alkenes (hydration, Hydroboration-oxidation, oxy-mercuration-demercuration) and carbonyl compounds (reduction and with Grignard reagent)

**Chemical properties:** Reactions involving cleavage of O-H bonds (acidity and esterification), oxidation (with PCC, Collins reagent, Jones reagent and  $\text{K}_2\text{Cr}_2\text{O}_7$ ) and catalytic dehydrogenation – distinction between primary, secondary and tertiary alcohols – Ascent and descent in alcohol series. Biofuel – ethanol and biodiesel.

**Dihydric alcohols:** Oxidative cleavage – Lead tetra acetate, periodic acid – Pinacol-pinacolone rearrangement.

**Phenols:** Preparation from halobenzenes, cumene and sulphonic acid. Chemical properties: Acidity of phenol - effect of substituents on acidity. Comparison of acidity with alcohol – bromination, nitration, sulphonation, Reimer-Tiemann reaction (mechanism expected), Kolbe reaction, Liebermann's nitroso reaction and Lederer-Mannasse reaction. Distinction between alcohols and phenols.

**Ethers:** Preparation by Williamson's synthesis. Reactions of ethers : Cleavage by HI and Claisen rearrangement (Mechanism expected) – Ziesel's method of estimation of methoxy group. Crown ethers: Nomenclature and importance of crown ethers.

**Epoxides:** Preparation from alkenes – acid and base catalysed ring opening reactions.

## Module II : Aldehydes and Ketones (12 hours)

Preparation: Oxidation of primary and secondary alcohols using PCC, reduction of esters using DIBAL-H, Rosenmund reduction, Gattermann-Koch formylation and Friedel-Craft's acylation.

Chemical properties: Nucleophilic addition (HCN, NaHSO<sub>3</sub>, RMgX and ROH)  
Addition-elimination reaction (with ammonia and ammonia derivatives)  
Reduction (Metal hydrides (mechanism expected), MPV reduction, Clemmenson and Wolff-Kishner reduction)

Oxidation: with KMnO<sub>4</sub>, Tollen's reagent, Fehling solution, Br<sub>2</sub> water, Oppenaur oxidation, Baeyer-Villiger oxidation.  
Acidity of α-hydrogen: Aldol, Claisen-Schmidt, Benzoin, Perkin and Knoevenagel condensations (Mechanisms expected).  
Haloform reaction – Iodoform test – Cannizaroreaction(mechanism expected) and Beckmann rearrangement(mechanism expected)

## Module III: Carboxylic acids, Sulphonic acid and their Derivatives (12 hours)

Preparation: Hydrolysis of nitrile, carboxylation of Grignard reagent and oxidation of alkyl benzenes.

Chemical properties: Acidity – effect of substituents on the acidity of aliphatic and aromatic carboxylic acids – HVZ reaction – Decarboxylation – Kolbe electrolysis (Mechanism expected). Ascent and descent series in aliphatic carboxylic acids.

Preparation, properties and uses of anthranilic acid, cinnamic acid, citric acid, lactic acid, oxalic acid, adipic acid and phthalic acid.

Formation of acid derivatives – acid chlorides, amides, acid anhydrides and esters – comparison of reactivity of acid derivatives. Preparation of coumarin – Fries rearrangement (Mechanism expected)

Preparation and reactions of benzene sulphonic acid, toluene sulphonic acid and benzene sulphonyl chloride – Importance of tosyl group – synthesis and application of saccharin.

## Module IV: Organic Nitrogen Compounds (12hours)

Nitrocompounds: Nitro-acitautomerism – Nef's reaction – reduction of nitrobenzene in various media – nitro compounds as explosives.

Amines: Classification – Preparation: From alkyl halides, nitro compounds, nitriles, isonitriles and amides – Hoffmann's bromamide reaction, Schmidt reaction, Gabriel phthalimide synthesis.

Chemical properties: Basicity (effect of substituents on the basicity of aliphatic and aromatic amines), Carbyl amine reaction, conversion of amines to alkene (Hoffmann elimination with mechanism), acylation and reaction with nitrous acid. Electrophilic substitution reactions of aniline: halogenation, nitration and sulphonation. Benzidine rearrangement (mechanism expected).

Separation of mixture of amines – methods to distinguish primary, secondary and tertiary amines.

Preparation and synthetic applications of diazonium chloride and diazomethane.

## Module V: Organic Spectroscopy I (12 hours)

UV – Visible spectroscopy – types of electronic transitions, effect of conjugation, concept of chromophore, auxochrome, bathochromic, hypochromic shifts, hyperchromic and hypochromic effects. UV-Visible spectra of enes. Calculation of  $\lambda_{\max}$  of dienes and  $\alpha,\beta$ -unsaturated ketones.

IR spectroscopy – Molecular vibrations - Functional group and finger print region – group frequencies – effect of hydrogen bonding on –OH stretching frequency – factors influencing carbonyl stretching frequency. Comparison of carbonyl stretching frequency in compounds containing carbonyl group.

Interpretation of IR spectra of simple organic molecules such as salicylaldehyde, benzamide, acetophenone, nitro benzoic acid and phenyl acetate.

Theory of Mass spectrometry – mass spectrum, base peak and molecular ion peak, types of fragmentation, McLafferty rearrangement, isotopic effect.

## Module VI Organic Spectroscopy II (6 hours)

NMR spectroscopy – principle of proton NMR – shielding and deshielding effect, chemical shift, factors influencing chemical shift, spin-spin splitting, coupling constant, interpretation of PMR spectrum of simple molecules like  $\text{CHBr}_2\text{CH}_2\text{Br}$ , ethylbromide, pure ethanol and impure ethanol (acidic impurities) acetaldehyde and toluene. Structural elucidation of simple organic molecules using IR and NMR spectroscopic techniques.

## Module VII: New Frontiers in Organic Chemistry (6 hours)

Supramolecular chemistry : Introduction – molecular recognition – host-guest interactions – types of non-covalent interactions .

Green chemistry : Introduction – atom economy – principles of greenchemistry.

Newer methods of synthesis : Ultrasound, microwaves and phase transfer catalysis. References

- (1) A.Bahl and B.S.Bahl, Advanced Organic Chemistry, S.Chand& Company, New Delhi.
- (2) L.G.Wade Jr, Organic Chemistry, Pearson Education, New Delhi.
- (3) K.S.Tewari, N.K.Vishnoi and S.N.Mehrotra, A textbook of Organic Chemistry, Vikas Publishing House (Pvt) Ltd., New Delhi..
- (4) S.C.Sharma and M.K.Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi..
- (5) P.L.Soni, Organic Chemistry
- (6) I L Finar, "Organic Chemistry" Vol – 1, 5<sup>th</sup> Edition, Pearson Education, New Delhi.
- (7) R.T.Morrison, R.N.Boyd. Organic Chemistry, Pearson Education, New Delhi.
- (8) P.Y.Bruice, Essential Organic Chemistry, Pearson Education, New Delhi.
- (9) J.Clayden, N.Greeves and S.Warren, Organic Chemistry, Oxford University Press, New York.
- (10) G.M. Louden, Organic Chemistry, Oxford University Press, New York.
- (11) V.K.Ahluwalia, Organic Reaction Mechanisms, Narosa Publishing House, New Delhi.
- (12). Y.R.Sharma, Elementary Organic Spectroscopy, Pearson Education, New Delhi
- (13) R.M.Silverstein and F.X.Webster, Spectrometric Identification of Organic Compounds, John Wiley and Sons, New York.
- (14) P.S.Kalsi, Application of Spectroscopic Techniques in Organic Chemistry, New Age International, New Delhi.
- (15) William Kemp, Organic Spectroscopy, Macmillan, New York.

- (16) D.L.Pavia, G.M.Lampman and G.S.Kriz, Introduction to Spectroscopy, Thomson Brooks Cole.  
 (17) Helena Dodzuik, Introduction to supramolecular chemistry, Springer.  
 (18) L.M. Lehn, Supramolecular Chemistry, VCH.  
 (19) M.M.Sreevastava and Rashmi Sanghi, Green Chemistry for environment, Narosa Publishing House.  
 (20) V.K.Ahluwalia, Green Chemistry, Environmentally Benign Reaction, Ane Book Pvt. Ltd.

University of Kerala  
 Model Question Paper of BSc Chemistry Programme  
 2017 Admission onwards  
 SEMESTER V Core Course VII Credit 4 Course Code CH1543  
 ORGANIC CHEMISTRY II

Time: 3 hours

Max. Marks : 80

SECTION – A

(Answer all questions. Answer in one word to maximum two sentences. Each question carries one mark)

1. What is Williamson's synthesis?
2. Which reagent is used for the oxidative cleavage of 1,2-diols?
3. Give a test to distinguish aliphatic aldehydes from aromatic aldehydes.
4. What is atom economy.
5. What is HVZ reaction?
6. What happens when aniline is treated with bromine?
7. Identify the types of electronic transitions in  $\text{CH}_3\text{CHO}$ .
8. What is base peak?
9. What is PTC?
10. Write the frequency range useful for the identification of organic compounds.

(10 X 1 = 10 Marks)

SECTION - B

(Short answer type. Answer any 8 questions from the following. Each question carries two marks.)

11. Why phenol is more acidic than methanol?
12. How can you convert isopropanol to tert.butyl alcohol?
13. What is iodoform test?
14. What is MPV reduction?
15. How coumarin is prepared?
16. How will you convert acetic acid to propionic acid?
17. Explain Nef's reaction.
18. Write the mechanism of Benzidine rearrangement?
19. What is finger print region? Give its importance.
20. Differentiate bathochromic and hypochromic shifts.
21. What is TMS? Why it is selected as a reference compound in H-nmr spectroscopy?
22. What is DIBAL? What is its use?

(8 X 2 = 16

Marks)

### SECTION - C

(Short essay type. Answer any 6 questions from the following. Each question carries four marks.)

23. Explain Zeisel's method of estimating methoxy group?
24. How can you distinguish primary, secondary and tertiary alcohol?
25. Write the importance of  $\text{LiAlH}_4$  and  $\text{NaBH}_4$  in carbonyl chemistry.
26. Comment on Clemmensen and Wolff-Kishner reduction.
27. How is cinnamic acid prepared? Explain its important properties.
28. Discuss Hoffmann elimination?
29. Explain microwave synthesis with examples.
30. (i) How can you distinguish inter and intra molecular hydrogen bonding using IR spectroscopy?  
(ii) Predict the regions where salicylaldehyde gives IR absorptions.
31. Explain spin-spin coupling with an example.

(6 X 4 = 24marks)

### SECTION - D

(Answer any 2 questions. Each question carries 15

marks) 32. (a) Write the mechanism of the following reactions: (a) Aldol condensation

and (b) Benzoin Condensation.

(b) Discuss the mechanism of (i) Reimer-Tiemann reaction and (ii) Claisen Condensation.

(c) Comment on the following (i) Biodiesel and (ii) Crown ethers.

33. (a) Explain the synthesis and applications of saccharin.

(b) How is diazonium chloride prepared? How is it useful in the synthesis of the following compounds: phenol, iodobenzene, azo compounds,

(c) How can you effect the following conversions (i) aniline to para-bromo aniline (ii) Benzamide to aniline.

34. (a) Discuss the Woodward-Fieser rule for calculating  $\lambda_{\text{max}}$  of dienes.

(b) Explain the principle of NMR spectroscopy.

(c) A compound with molecular formula  $\text{C}_8\text{H}_8\text{O}$  shows the following absorptions:

(i) IR Spectrum: 3050, 2950, 1700, 1620, 1550, 690  $\text{cm}^{-1}$ .

(ii) pmr spectrum:  $\delta$  7-8 ppm (multiplet, 5H), 2.5 ppm (singlet, 3H).

Identify the structure of the compounds.

35. (a) How are primary, secondary and tertiary amines separated?

(b) Discuss the preparation and important reactions of benzene sulphonic acid.

(c) Discuss the different types of non-covalent interactions in molecules.

(15 X 2 = 30marks)

### B.Sc. Chemistry Programme

Semester – VI Course VIII Course Code – CH1641 Credit-4 Physical Chemistry – II Total: 72 hours

**Aim of the course:** To learn statistical mechanics which explains the chemical and physical properties and dynamics in the thermodynamic limit from a knowledge of the microscopic properties of the constituent atoms and molecules of a bulk system. The concepts of quantum mechanics and spectroscopy which provide a complete description of chemistry at the microscopic level, form the basis for the course.

**Objectives:** Students will explain and apply the concepts of thermodynamics, quantum mechanics, and spectroscopy to chemical, physical, and biochemical systems. Students will be able to derive essential mathematical relationships in thermodynamics, quantum mechanics, and spectroscopy. Students will evaluate physical and chemical systems by non-spectroscopic techniques.

**Module I – Thermodynamics III & Statistical thermodynamics 12 hrs**

Nernst heat theorem, proof and its consequences. Statement of Third Law-Planck's statement, Lewis-Randall statement. Concept of perfect crystal, evaluation of absolute entropies of solid, liquid and gas. Exception to Third Law with reference

to examples- CO, NO, N<sub>2</sub>O and H<sub>2</sub>O Phase space, system, assembly and ensemble-types of ensembles and uses. Thermodynamic probability, Boltzmann distribution law (no derivation). Partition function, entropy and probability. Thermodynamic functions in terms of partition functions - internal energy, enthalpy, pressure, work function and free energy function.

#### Module II – Colloids and Adsorption 12 hrs

Colloidal state: Classification of colloids, Purification of colloids – ultra filtration and electro dialysis, Kinetic, optical and electrical properties of colloids. Ultra microscope, Electrical double layer and zeta potential. Coagulation of colloids, Hardy-Schulz rule, Gold number. Gels: Elastic and non-elastic gels, Imbibition and syneresis, Micelles and critical micelle concentration, sedimentation and streaming potential, Application of colloids – Cottrell precipitator, purification of water and delta formation.

Adsorption: Physical and chemical adsorption, Freundlich adsorption isotherm, Derivation of Langmuir adsorption isotherm, Statement and explanation of BET and Gibbs isotherms, determination of surface area of adsorbents by BET equation. Applications of adsorption.

#### Module III – Quantum mechanics - 12 hrs

Radiation phenomena- blackbody radiation, photoelectric effect, Compton effect and atomic spectra. Plank's quantum theory and explanation of the radiation phenomena. Schrodinger wave equation – significance of  $\Psi$ , well behaved functions, Concept of operators and some operators of interest (properties of operators not required), Postulates of quantum mechanics Application of quantum mechanics to simple systems - particle in 1 D box, normalization of wave function, Particle in 3 D box. Concept of degeneracy. Application to hydrogen atom (no derivation) Schrodinger wave equation in Cartesian and spherical polar co-ordinates, Quantum numbers.

#### Module IV – Spectroscopy – 12 hrs

Regions of electromagnetic spectrum. Different units of energy (erg, joule, calorie, cm<sup>-1</sup>, Hz, A<sup>0</sup> and eV) and their inter conversions. Interaction of radiations with matter. Various types of molecular spectra. Born-Oppenheimer approximation.

Rotational spectroscopy: microwave spectra of diatomic molecules, energy expression, selection rule, rotational energy levels, determination of bond length.

Vibrational spectroscopy: Harmonic oscillator. IR spectra of diatomic molecules. Energy expression. Selection rules, frequency of separation, calculation of force constant, anharmonic oscillators. Morse equation. Fundamental and overtone transitions, combination bands, degree of freedom of polyatomic molecules.

Raman spectroscopy: Stoke's and antistoke's lines and their intensity difference, rotational Raman spectrum. Selection rule. Frequency of separation, vibrational Raman spectrum, Mutual exclusion principle.

#### Module V – Spectroscopy – II 12 hrs

Electronic spectroscopy: Frank-Condon principle. Singlet and triplet states. Electronic spectra and diatomic molecules. Dissociation energy, electronic spectra of polyatomic molecules (qualitative idea only).

NMR spectroscopy: Principle of NMR, nuclear spin. Interaction of nuclear spin with external magnet. Precession. Relaxation, Chemical shift. Low resolution spectra. Delta and tau scales. Spin-spin coupling and high resolution spectra, application of NMR in MRI.

Electron spin resonance spectroscopy: principle. Types of substances with unpaired electrons, interaction of electron magnet with external magnet. Energy level splitting. Lande splitting factor, presentation of ESR spectrum. The normal and derivative spectra. Hyperfine splitting. Simple examples like methyl and benzene radicals.

Introduction to Mossbauer Spectroscopy

#### Module VI – Non-spectroscopic methods 12 hrs

Non-spectroscopic methods: Dipole moment, Debye equation and Clausius-Mosotti equation, measurement of dipole moment by temperature method, Dipole moment and molecular structure, Diamagnetism and paramagnetism, Magnetic susceptibility and unpaired electrons, measurement of magnetic susceptibility, Molar refraction and molecular structure, Atomic refraction, Optical exaltation, Parachor and atomic equivalent of para chor.

(At least 100 problems are to be worked out from all units together. 30% of the questions for Examination shall contain problems.)

## References

1. P W Atkins, "Physical Chemistry", Oxford University Press
2. R J Silby and R A Albery, "Physical Chemistry", John Wiley & Sons
3. G W Castellan, "Physical Chemistry", Narosa Publishing House
4. Puri, Sharma and Pathania, "Principles of Physical Chemistry", Millennium Edition, Vishal Publishing Co.
5. Gurdeep Raj, "Advanced Physical Chemistry", Goel Publishing House.
6. S Glasstone, "Thermodynamics for Chemists", Affiliated East West Publishers
7. M C Gupta, "Elements of Statistical Thermodynamics", New Age International (P) Ltd.
8. L K Nash, "Elements of Statistical Thermodynamics", Addison Wesley
9. A W Adamson, "The Physics and Chemistry of Surfaces", Interscience
10. N K Adam, "The Physics and Chemistry of Surfaces", Oxford University Press
11. M W Hanna, "Quantum Mechanics in Chemistry", Benjamin
12. I N Levine, "Quantum Chemistry", Prentice Hall
13. C N Banwell, "Fundamentals of Molecular Spectroscopy", Tata McGraw Hill
14. Manas Chanda, "Atomic structure and Chemical bonding in Molecular Spectroscopy", Tata McGraw Hill
15. Physical Chemistry, R. Stephen Berry, Stuart A Rice & John Rose 2nd Edn Oxford
16. A.S.Negi and S.C.Anand, A text book of Physical Chemistry, New Age International publishers.

University of Kerala  
Model Question Paper of B.Sc. Chemistry Programme  
2017 admission onwards  
Semester VI Core Course-VIII Course Code CH1641 Credit-4  
Physical Chemistry II

Time: 3 Hrs

Total marks: 80

Section A.

Answer all the questions. Each question carries 1 mark

1. Which of the following will give pure rotational spectrum?  $H_2$ ,  $N_2$ ,  $CO_2$ ,  $HCl$ .
2. Write the mathematical definition of Laplacian operator.
3. Which branch of spectroscopy is used for the identification of free radicals?
4. What is the significance of polarizability of a molecule?
5. What is responsible for the stability of a lyophilic sol?
6. State The Heisenberg uncertainty principle.
7. Give the expression for Freundlich adsorption isotherm.



8. Give the expansion of STM.
9. Give the selection rule for rotational spectroscopy.
10. What is the unit of dipole moment?

Section B,

(2 marks each), [Short answer]. Answer any 8 questions

11. What is meant by Critical Micelle Concentration (CMC)?
12. What is sedimentation?
13. What is the significance of wave function of a particle?
14. Give any two applications of ESR spectroscopy.
15. What do you mean by the term 'parachor'?
16. What is meant by normal modes of vibrations?
17. What is zeta potential ?
18. Calculate the number of fundamental modes of vibrations of CO<sub>2</sub> and SO<sub>2</sub> molecules.
19. How does Stokes and anti Stokes lines originate in Raman spectrum.
20. Explain chemical shift.
21. Explain blackbody radiation
22. What is hyperfine splitting in esr?

Section C

Each question carries 4 marks(Short essay), Answer any 6 questions

23. What is an ensemble, explain the different types of ensembles.
24. Discuss the postulates of quantum mechanics.
25. Explain the underlying principle of NMR spectroscopy.
26. What is meant by Optical Exaltation? Calculate the optical exaltation of 2,6-dimethylhepta-2,5-dien-4-one.
27. Compare physisorption and chemisorptions
28. What are the consequences of unharmonicity in vibrational spectroscopy?
29. What is Debye equation ? Explain its significance.
30. Explain mutual exclusion rule with examples.
31. The fundamental vibrational frequency of carbon monoxide molecule is 2170. cm<sup>-1</sup> Calculate the force constant of the molecule.

Section D,

15 marks each (Long essay) Answer any two question

32. a) Derive and explain Langmuir adsorption isotherm. (5 marksx3 = 15)  
 b) What is meant by partition functions? Derive expressions for internal energy and enthalpy.  
 c) The acceptable solutions to Schrodinger wave equation must have some special properties. What are these? Elaborate.
33. a) What is Hardy-Schulze rule and what are the principles involved in the mechanism of coagulation? (5 marksx3 = 15)  
 b) Show that for a rigid diatomic rotor, the moment of inertia is given by  $I = \mu r^2$   
 c) The pure rotational spectrum of a gaseous molecule CN consists of a series of equally spaced lines

separated by  $3.7978\text{cm}^{-1}$ . Calculate the internuclear distance of the molecule. The molar masses are;  $^{12}\text{C}=12.011$  and  $^{14}\text{N}=14.007\text{ g mol}^{-1}$ .

34. a) How can NMR spectrum distinguish between the isomers: p-xylene and ethyl benzene?  
(5 marks x3 = 15)
- b) Explain the shielding and deshielding mechanism in NMR.
- c) Give the hyperfine structure of ESR spectrum of hydrogen atom. Calculate the ESR frequency of an unpaired electron in a magnetic field of 0.33T. Given  $g_e = 2$  and  $\mu_B = 9.273 \times 10^{-24}\text{ JT}^{-1}$ .
35. a) Discuss the function of a protective colloid. (5 marks x3 = 15)
- b) What is meant by electro dialysis?
- c) Explain BET theory.

B.Sc. Chemistry Programme

SEMESTER VI Core Course IX Credit – 4 Course Code CH1642

Organic Chemistry Paper – III Total  
: 54 hours

Lecture - Tutorial – Lab: 3-0-2

Aim of the Course:

The syllabus deals with organic compounds carbohydrates, amino acids, proteins, nucleic acids, oils, fats, detergents, vitamins, terpenes, alkaloids, and polymers and their properties

Objective of the Course: The students will get an interesting idea about the preparation and properties mechanism of reactions of many organic conversions and of organic compound.

### Module I: Carbohydrates

Classification and nomenclature of monosaccharides, configuration of monosaccharides. Reactions of glucose and fructose – structure of glucose and fructose – anomers and mutarotation (mechanism expected) - cyclic structure – pyranose and furanose forms – determination of ring size – Haworth projection formula – chair conformations.

Epimers and epimerization – Interconversion of aldoses and ketoses – chain lengthening and shortening of aldoses.

Disaccharides – reactions and structure of sucrose (structural elucidation not required)

Polysaccharides – Structure of starch and cellulose (structural elucidation not required) – Industrial applications of cellulose.

### Module II: Heterocyclic compounds and Drugs (9 hours)

Heterocyclic compounds – classification – nomenclature – aromaticity.

Preparation (special reference to Paal-Knorsynthesis and Hantzsch synthesis) and properties of furan, pyrrole, thiophene and pyridine. Basicity of pyridine and pyrrole.

Synthesis and reactions of quinoline, isoquinoline and indole with special reference to Skraup, Bischler-Napieralski and Fischer-Indole synthesis. Structural elucidation of quinoline.

Structure of purine and pyrimidine bases.

Chemotherapy – Drugs – introduction – classification – Synthesis of sulphanilamide, sulphathiazole and sulphapyridine. mode of action of sulphadiazole and ampicillin. Elementary idea of the structure and application of chloroquine, paracetamol and aspirin.

### Module III: Amino acids, proteins and nucleic acids (9hours)

Amino acids – classification, structure and stereochemistry of amino acids, essential and non essential amino acids – zwitter ion, isoelectric point.

Synthesis of amino acids – Strecker synthesis, amidomalonnate synthesis, Erlenmeyer azlactone synthesis.

Peptides: Structure and synthesis ( Carbobenzoxy, Sheehan and solid phase synthesis)

Proteins – classification of proteins –structure of proteins –denaturation and colour reactions.

Nucleic acids: Classification and structure of DNA and RNA. Replication of DNA. Transcription and Translation - Genetic code.

### Module IV: Natural products (9 hours)

Terpenes – Classification - Isoprene rule - Essential oil – Source, structure, (no structural elucidation) and uses of citral and geraniol, limonene and menthol. Structure of natural rubber – vulcanization and its advantages.

Alkaloids – Extraction and structural elucidation of coniine and nicotine. Importance of quinine, morphine and codeine.

Vitamins : Classification, structure, functions and deficiency diseases (structure of vitamin A, B1 and C only - but no structural elucidation).

Lipids – biological functions – oils and fats – common fatty acids – hydrogenation – rancidity - saponification value, iodine value, acid value.

### Module V: Soaps, Detergents and Polymers (9 hours)

Soaps and detergents: Soap – synthetic detergents – cleaning action of soap and detergents.

Polymers: General idea of monomers, polymers and polymerisation – Degree of polymerisation – polydispersity - number and weight average molecular mass.

Classification of polymers, Homopolymers and copolymers, Addition and condensation polymers, thermoplastics and thermosets – mechanism of addition polymerization (Cationic, anionic and free radical) – Tacticity – role of ZieglerNatta catalyst in directing the tacticity in polypropylene (mechanism not required).

Addition polymerisation. Preparation and uses of (i) polyethylene (ii) PVC (iii) Teflon

Condensation polymerisation:(i) phenol-formaldehyde resin (ii) epoxy resin (iii)nylon-66

(iv) polyethylene terephthalate. Synthetic rubbers – SBR and nitrile rubbers. Biodegradable polymers Additives to polymers – Plasticisers, stabilizers and fillers

### Module VI: Organometallics, Active methylene compounds and Reagents in Organic synthesis.( 9 hours )

Organomagnesium compounds: Grignard reagent: Preparation – Reaction with compounds containing acidic hydrogen, carbonyl compounds, cyanides and CO<sub>2</sub>.

Organo lithium compounds: Preparation – Reaction with compounds containing acidic hydrogen, alkyl halides, carbonyl compounds, cyanides and CO<sub>2</sub>.

Organo zinc compounds: Preparation of dialkyl zinc – Reaction with active hydrogen compounds, acid halides and alkyl halides – Reformatsky reaction (mechanism expected)

Li dialkylcuprates – Preparation and reaction with aliphatic/aromatic/vinyl halides.

Active methylene compounds – examples – Preparation of ethyl acetoacetate by Claisen condensation (mechanism expected) – tautomerism – Synthetic applications of acetoacetic ester.

Reagents in organic synthesis: Study of the following reagents with respect to functional group transformations –

- (1) LiAlH<sub>4</sub> – reduction of =CO, -COOR and -CONH<sub>2</sub>.
- (2) NaBH<sub>4</sub> and Diborane – reduction of =CO
- (3) SeO<sub>2</sub> - hydroxylation of allylic and benzylic positions, oxidation of CH<sub>2</sub> alpha to =CO to =CO
- (4) NBS : Allylic and benzylic bromination.

References:

- (1) A.Bahl and B.S.Bahl, Advanced Organic Chemistry, S.Chand & Company, New Delhi.
- (2) L.G.Wade Jr, Organic Chemistry, Pearson Education, New Delhi.
- (3) K.S.Tewari, N.K.Vishnoi and S.N.Mehrotra, A textbook of Organic Chemistry, Vikas Publishing House (Pvt) Ltd., New Delhi..
- (4) S.C.Sharma and M.K.Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi..
- (5) P.L.Soni, Organic Chemistry.
- (6) I L Finar, "Organic Chemistry" Vol – 1&2, 5<sup>th</sup> Edition, Pearson Education, New Delhi.
- (7) R.T.Morrison, R.N.Boyd. Organic Chemistry, Pearson Education, New Delhi.
- (8) P.Y.Bruice, Essential Organic Chemistry, Pearson Education, New Delhi.
- (9) J.Clayden, N.Greeves and S.Warren, Organic Chemistry, Oxford University Press, New York.
- (10) G.M. Louden, Organic Chemistry, Oxford University Press, New York.
- (11) Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, Polymer Science, Wiley Eastern Ltd, New Delhi.
- (12) Billmeyer F.W., Text book of Polymer Science, John Wiley and Sons.
- (13) S.M.Mukerji and S.P.Singh, Reaction Mechanism in Organic Chemistry, McMillan Publishers.
- (14) S.P.Bhutani, Chemistry of Biomolecules, Ane Book Pvt Ltd.
- (15) O.P.Agarwal, Chemistry of Natural Products, Goel Publications.
- (16) T.L.Gilchrist, Heterocyclic Chemistry, Pearson Education, New Delhi.
- (17) V.K.Ahluwalia, Organic Reaction Mechanisms, Narosa Publishing House, New Delhi.

University of Kerala  
MODEL QUESTION PAPER SEMESTER VI  
First Degree Programme in Chemistry  
Semester VI Core Course – IX Course Code CH1642 Credit 4  
ORGANIC CHEMISTRY III  
2017 admission onwards

Time: 3 hours

Max. Marks : 80

SECTION – A

(Answer all questions. Answer in one word to maximum two sentences. Each question carries one mark)

1. Draw the structure of D-Arabinose and D-Ribose?
2. What are epimers?
3. Write the IUPAC name of (i) Furan and (ii) quinoline.
4. Write the structure of chloroquine.
5. What is isoelectric point?
6. What is natural rubber chemically?
7. Write any two biological functions of lipids.
8. What is soap?
9. Write the monomers of the following polymers (i) PTFE (ii) PP.
10. What is Frankland reagent? (10 X 1 = 10 Marks)

SECTION - B

(Short answer type. Answer any 8 questions from the following. Each question carries two marks.)

11. Explain inversion of cane sugar.
12. Write any two industrial applications of cellulose.
13. Compare the aromaticity of furan and thiophene.
14. Write the structure of pyrimidine bases present in nucleic acids.
15. Define the terms (i) saponification value and (ii) iodine value.
16. What is isoprene rule?
17. What are essential and non-essential amino acids?
18. What is denaturation of protein?
19. Differentiate oils and fats.
20. Define the terms  $M_n$  and  $M_w$ .
21. What is NBS? What is its use?
22. What are active methylene compounds? Give examples.

(8 X 2 = 16 Marks)

SECTION - C

(Short essay type. Answer any 6 questions from the following. Each question carries four marks.)

23. How can you interconvert glucose and fructose?
24. What is mutarotation? Explain its mechanism.
25. Explain the synthesis of amino acid by (i) Strecker and amidomalonnate synthesis.
26. What are vitamins? How are they classified? Write the structure of Vitamin A and C.
27. What is tacticity? Explain it by taking poly propylene as an example.
28. What is Bakelite? How is it prepared? Give its important applications.
29. Write a short note on the structure of DNA.
30. Discuss the mechanism of Reformatsky reaction.
31. Elucidate the structure of conine.

(6 X 4 =

24marks) SECTION – D

(Answer any 2 question. Each question carries 15 marks)

32. (a) Discuss the cyclic structure of glucose  
(b) Briefly explain the structure of starch and cellulose.  
(c) (i) Why glucose and fructose form same osazone?  
(ii) How fructose reacts with the following reagents? (1) Na/Hg and H<sub>2</sub>O (2) CH<sub>3</sub>OH and dry HCl (3) Fehling's solution.
33. (a) Explain the Fischer-Indole synthesis.  
(b) What are sulphadugs? Give examples. Explain the mode of action of sulphadugs.  
(c) What are terpenes? How are they classified? Write the structure of limonene and menthol.
34. Write brief note on the following : (a) Replication of DNA  
(b) Merrifield synthesis  
(c) Structure of protein
35. (a) Explain the synthetic applications of ethyl acetoacetate.  
(b) How Grignard reagent is prepared? Explain its importance in the synthesis of primary, secondary, tertiary alcohols and carboxylic acid. (c) Explain the mechanism of cationic and anionic polymerization.

(15 X 2 = 30marks)

B.Sc. Chemistry Programme  
Semester VI Core Course –X Course Code – CH1643 Credit 4  
PHYSICAL CHEMISTRY- PAPER III [72 hours]

Aim of the course: To provide an insight into the thermodynamic and kinetic aspects of chemical reactions and phase equilibrium. To give an insight to the various electrochemical systems.

Objectives: The main objective of the course is to study the basics of electrochemistry and its importance to modern industry and technology. The course introduces various types of reactions and the different factors that determine the rate of chemical changes. The course also includes the study of the phase diagrams of one, two and three component systems and elementary ideas of photochemistry.

Module I: Chemical Kinetics & Catalysis

12 hrs

Order of reaction, Derivation of integrated rate equation of zero, first, second and nth order reaction, determination of order of reactions:- Graphical and analytical methods using integrated rate equations, Fractional life- method, Differential rate equation method, Isolation method. Qualitative idea of Complex reactions:- (a) opposing reactions (b) first order consecutive reactions (c) parallel reactions. Qualitative idea of chain reactions. Influence of temperature on rate of reaction: Arrhenius equation, Determination of Arrhenius parameter, Energy of activation and its significance. Collision theory, Derivation of the rate equation for a second order reaction based on collision theory, unimolecular reactions- Lindemann mechanism, steady state approximation.  
Catalysis:- Theories of catalysis, Intermediate compound formation theory, steady state method, Enzyme catalysis, Michaelis-Menten law.

Module II: Chemical and Ionic Equilibria

12 hrs

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, relation between K<sub>p</sub>, K<sub>c</sub> and K<sub>x</sub>. Le-Chatelier's Principle – Application in Haber process and dissociation of PCl<sub>5</sub>. Reaction isotherm, Temperature dependence of equilibrium constant, Pressure dependence of equilibrium constant, Application of Clausius-clapeyron equation in physical equilibria.

Ionic equilibrium : Ionic product of water, Effects of solvents on ionic strength, levelling effect, Pka and Pkb values, solubility product and common ion effect and their applications, pH and its determination by indicator methods, buffer solution, buffer action, Henderson's equation, buffer capacity - hydrolysis of salts of all types, degree of hydrolysis and hydrolytic constant, determination of degree of hydrolysis, relation between hydrolytic constant and ionic product of water

### Module III: Phase Equilibria

12 hrs

Phase Equilibria:-Terminology, the phase rule, thermodynamic derivation of phase rule and its application to (a) water system (b) sulphur system (c) solid-liquid equilibria involving simple eutectic system such as Pb-Ag system, KI-water system, freezing mixtures, thermal analysis and desilverisation of lead (d) solid-liquid equilibria involving compound formation with congruent and incongruent melting points:-  $\text{FeCl}_3\text{-H}_2\text{O}$  system and  $\text{Na}_2\text{SO}_4\text{-H}_2\text{O}$  system (e) solid-gas system- decomposition of  $\text{CaCO}_3$ , dehydration of  $\text{CuSO}_4\cdot 5\text{H}_2\text{O}$ , deliquescence and efflorescence.

### Module IV: Binary Liquid Systems

12 hrs

Liquid-Liquid system:- Completely miscible, ideal and non-ideal mixtures, Raoult's law, vapour pressure- composition and temperature-composition curves, fractional distillation, deviation from Raoult's law, Azeotropic mixtures, partially miscible liquid system, critical solution temperature, Conjugate layers, example for upper, lower and upper cum lower CST, Introduction to three component system, distribution law, its thermodynamic derivation, limitations of distribution law, application of distribution law to the study of association and dissociation of molecules, solvent extraction. (9hrs) Photochemistry: .

Grothus-Draper, Beer- Lambert and Stark- Einstein laws, Quantum yield, Reason for very low and very high quantum yields, Rate equation for decomposition of hydrogen iodide, Qualitative treatment of  $\text{H}_2\text{-Cl}_2$  reaction and  $\text{H}_2\text{-Br}_2$  reaction, Fluorescence and phosphorescence, chemiluminescence and photosensitization, Explanation and examples . (3hrs)

### Unit V: Electromotive Force

15 hrs

Electrochemical cells(brief explanation) Reference electrodes-standard hydrogen electrode, calomel electrode, Types of electrodes-Metallic electrodes, anion reversible electrodes and redox electrodes, Electrode reactions and cell reactions, Derivation of Nernst equation for electrode potential and cell potential, Gibb's Helmholtz equation and EMF of a cell, calculation of  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  from EMF data. Concentration cells with and without transference, electrode and electrolyte concentration cells, derivation of equation for the EMF of concentration cells with and without transference, Liquid Junction Potential,. Introduction to over voltage and polarization. Applications of potential measurement:- Determination of ionic product of water, hydrolysis constant and solubility product, pH value using quinhydrone and glass electrode, potentiometric titrations of acid-base and redox reaction. (12hrs)

Fuel cells :- Hydrogen-Oxygen fuel cell, Hydrocarbon – Oxygen fuel cell

Primary-Mercury cell, Dry cell and secondary cells –Lead acid cell, Li-ion cell Corrosion, Prevention of corrosion . (3hrs)

### Module VI: Electrical Conductance

9

hrs

Inter ionic attraction theory, Debye-Huckel-Onsager equation (Qualitative treatment only) activity and activity coefficient of electrolytes, Kohlrausch's law and its applications , Wein effect, Debye-Falkenhagen effect, Walden's rule. Ionic mobilities:- Transference number and its determination by Hittorff's and moving boundary methods, abnormal transference numbers, Applications of conductivity measurements:- Determination of degree of dissociation of weak electrolytes, degree of hydrolysis, solubility of sparingly soluble salts, conductometric titrations involving strong acid - strong base, strong acid-weak base, weak acid- strong base, weak acid-weak base and precipitation.

At least 100 problems are to be worked out from all units together. 30% of the questions for Examination shall contain problems.

References:

1. Advanced Physical Chemistry ,Gurdeep Raj, Goel publishing house
2. Elements of Physical Chemistry ,Glasstone and Lewis,Macmillan
3. Physical Chemistry ,P.C.Rakhit,Sarat Book House,Calcutta
4. A Text book of Physical Chemistry ,K.L.K.Kapoor,Vol 1,3 & 4, Macmillan

5. Physical Chemistry, R. Stephen Berry, Stuart A. Rice & John Ross 2nd Edn, Oxford
6. Physical Chemistry, Levin, 5th edn, TMH
7. Physical Chemistry, G.M. Barrow, 6th edn, The McGRAW-HILL Companies, INC
8. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co
9. A.S. Negi and S.C. Anand, A text book of Physical Chemistry, New Age International publishers.

University of Kerala  
 Model Question Paper of B.Sc. Chemistry Programme  
 2017 admissions onwards  
 Semester VI Core Course X: Course Code CH1643 Credit 4  
 Physical Chemistry – III

Time: 3 Hrs

Total marks: 80

Section A

Answer all the questions Each question carries 1 mark

1. Give the Arrhenius equation.
2. Write the integrated rate equation for a first order reaction.
3. Give the relation between hydrolytic constant, dissociation constant and ionic product of water of a salt of strong acid and weak base.
4. The solubility of AgCl in water at 25°C is 0.00179 g/L. calculate its solubility product at 25 °C.
5. Write Debye- Huckel- Onsager equation.
6. Write the reduced phase rule equation.
7. Give an example for a system having upper cum lower CST.
8. Give the Nernst equation for the potential of a copper electrode.
9. What is meant by quantum yield of a photochemical reaction?
10. Represent the electrochemical cell formed when Zn electrode is coupled with Ag electrode.

Section B

Each question carries 2 marks (Short answer) .Answer any 8 questions

11. Define buffer solution and buffer index .
12. Define the term activation energy. Why different reactions proceed at different rates? 13. Give one example each for a consecutive and a parallel reaction
14. What is meant by common ion effect? Explain with an example.
15. Describe with example (i) Triple point (ii) Eutectic point
16. Explain the term congruent melting point with an example
17. Write a note on conductometric titration of acetic acid against sodium hydroxide?
18. What is Debye Falkenhagen effect?
19. How will you construct a calomel electrode?
20. What is meant by liquid junction potential? How can it be almost eliminated?
21. What are azeotropes ? Explain with an example.
22. What is critical solution temperature? How does it vary by the addition of an electrolyte?



### Section C

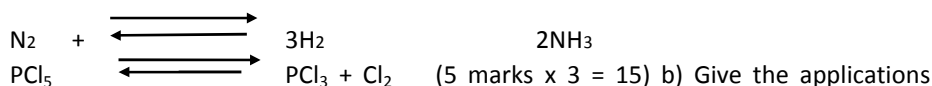
Each question carries 4 marks (Short essay). Answer any 6 questions

23. The rate constant of a second order reaction is  $5.70 \times 10^{-5} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$  at  $25^\circ\text{C}$  and  $1.64 \times 10^{-4} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$  at  $40^\circ\text{C}$ . Calculate the activation energy and the Arrhenius preexponential factor.
24. What would be the pH of a solution obtained by mixing 5 g of acetic acid and 7.5 g of sodium acetate and making the volume equal to 500 ml? Dissociation constant of acetic acid at  $25^\circ\text{C}$  is  $1.75 \times 10^{-5}$ .
25. Explain the principle of freezing mixture by taking KI – H<sub>2</sub>O system as an example.
26. State and explain Nernst distribution law. What are the limitations of the law?
27. What are fuel cells? Describe H<sub>2</sub> – O<sub>2</sub> fuel cell and its cell reactions.
28. Derive Clausius- Clapeyron equation and mention its applications . 29.Explain the terms (i) Fluorescence (ii) Phosphorescence
30. What are the laws of photochemistry , explain ?
31. Explain the phase diagram of Pb-Ag system.

### Section D

Each question carries 15 marks (essay) Answer any two question

32. a) using Le Chatliers Principle, describe the effect of temp, P and concentration for the following systems in equilibria:



Nernst distribution law.

c) Elaborate on azeotropic mixtures.

33. a) How will you determine the transport number of ions using Hittorf method? (10 marks)  
b) Give the construction and working of SHE. (5 marks)
34. a) Derive van't Hoff equation for temperature dependence of equilibrium constant. (10 marks)  
b) The equilibrium constant for a reaction is  $1 \times 10^5$ . Calculate the standard free energy change for the reaction in kilojoules at  $25^\circ\text{C}$ . (5 marks)
35. a) What is meant by CST. Explain different types of CST with examples (5 marks)  
b) Discuss various types of concentration cells. (10 marks)

For all Lab courses scheme of ESE is decided by the board examiners in each year

First Degree B.Sc Programme in Chemistry Lab course Semester II,

PART B. LABORATORY

COMPUTER LABORATORY

[No ESA for this component]

Computer Lab based instruction on the use of computer and internet in learning. Use of educational softwares, information mining from internet and using INFLIBNET/NICNET, NPTEL and VIRTUAL LABS OF MHRD. Word processing and document preparation. Use of Spread sheets in Data handling and presentation. Introduction to chemical structure drawing, visualization of molecules using chemistry softwares.

First Degree B.Sc Programme in Chemistry  
SEMSTER I, III & IV Core Course-II Course Code CH1442  
(Lab Course I) Core Course-IV  
Three hours examination in semester IV. (Credit 2)

I. Qualitative Analysis (Micro Analysis)

- a. Studies of the reactions of the following radicals with a view to their identification and confirmation:  
 $Pb^{2+}$ ,  $Cu^{2+}$ ,  $Bi^{2+}$ ,  $Cd^{2+}$ ,  $Sn^{2+}$ ,  $Sb^{2+}$ ,  $Fe^{2+}$ ,  $Fe^{3+}$ ,  
 $Al^{3+}$ ,  $Cr^{3+}$ ,  $Zn^{2+}$ ,  $Mn^{2+}$ ,  $Co^{2+}$ ,  $Ni^{2+}$ ,  $Ca^{2+}$ ,  $Sr^{2+}$ ,  $Ba^{2+}$ ,  $Mg^{2+}$ ,  $K^+$ ,  $NH_4^+$ ,  $CO_3^{2-}$ ,  $S^{2-}$ ,  $NO_2^-$ ,  $NO_3^-$ ,  $F^-$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $BO_3^-$ ,  
acetate, oxalate,  $CrO_4^{2-}$ ,  $PO_4^{3-}$  and  $SO_4^{2-}$ .
- b. Systematic qualitative analysis by microscale methods of a mixture containing two acidic and two basic radicals from the above list (not more than one interfering radical). II. Inorganic Preparations

The following preparations are to be done:-

- a. Potash alum
- b. Hexamine cobalt
- c. Chloride
- d. Tetramine copper
- e. Sulphate
- f. Mohr's salt
- g. Microcosmic salt
- h. Sodium cobalti nitrate
- i. Sodium nitro pruside
- j. Manganese phthalocyanin
- k. Potassium trioxalatochromate and
- l. Potassium trioxalatoferate

Semester V & VI Core Course- VIII Course Code CH1544 Inorganic Volumetric Analysis (Lab  
Course Number II)  
and Core Course-IX physical Chemistry Experiments Course code 1545(Lab Course Number III)  
(Credit 3) Six hours examination in semester VI

Inorganic Volumetric analysis- one burette titration only

(a) Acidimetry and alkalimetry

Preparation of carbonate free sodium hydroxide. Use of constant boiling hydrochloric acid  
Titrations using (1) Strong acid – strong base (2) Strong base – weak acid (3) Strong acid – weak base,  
determination of  $Na_2CO_3$  and  $NaHCO_3$  in a mixture by indicator method and  $NH_3$  in an ammonium salt by  
direct and indirect methods.

### (b) Permanganometry

The following determinations are to be done using standard permanganate solution (1) Ferrous iron (2) Oxalic acid (3) Hydrogen peroxide (4) Calcium (5) Nitrite and (6)  $\text{MnO}_2$  in pyrolusite.

### (c) Dichrometry

Determination of Ferrous iron using internal (& external indicator) and Ferric iron after reduction with  $\text{SnCl}_2$ .

### (d) Cerimetry

Standardisation of ceric ammonium sulphate with Mohr's salt. Determination of oxalic acid using ceric ammonium sulphate. (e) Iodometry

Standardisation of thiosulphate using  $\text{KIO}_3$ , electrolytic copper and potassium dichromate. Determination of a copper salt.

### (f) Precipitation titration

Determination of chloride in neutral medium. (g) Complexometry (using EDTA)

Standardisation of EDTA solution with  $\text{ZnSO}_4$  – determination of Zn, Mg, Ni and Ca – determination of permanent and temporary hardness of water.

## Physical Chemistry Practicals

The following experiments are to be done :

Determination of

1. Partition coefficient of iodine between  $\text{CCl}_4$  and  $\text{H}_2\text{O}$  or Partition coefficient of ammonia between  $\text{CHCl}_3$  and  $\text{H}_2\text{O}$
2. Transition temperature of a salt hydrate. Molar mass of a solute using transition point depression of a salt hydrate.
3. Depression in freezing point of a solid solvent by cooling curve method. Molar mass of a solute.
4. Critical solution temperature of phenol – water system.
5. Viscosity of binary mixtures and then concentration of an unknown mixture.
6. Surface tension of binary mixtures and then concentration of an unknown mixture.
7. Refractive indices of KCl solutions of different concentrations and then concentration of an unknown KCl solution.
8. Conductometric titration of NaOH Vs HCl.
9. Potentiometric titration of  $\text{Fe}^{2+}$  vs  $\text{Cr}_2\text{O}_7^{2-}$
10. Potentiometric titration of  $\text{KMnO}_4$  Vs KI
11. Determination of water equivalent of a calorimeter and heat of neutralisation of strong acid – strong base.
12. Kinetics of hydrolysis of an ester
13. Influence of KCl impurity on miscibility temperature of phenol – water system and then the determination of concentration of a given KCl solution.

## 2.COMPUTER SOFTWARE

### Use of softwares and programmes in the physical chemistry experiments

- 1.Computer software like Scilab, Excel, etc to solve some of the plotting or calculation problems.
  - 2.Determination of equivalence point of potentiometric and conductometric titrations using spreadsheet program.
  3. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant)
  - 4.Plot scatter diagram.
  5. Basic idea of software like Chems sketch or Chemdraw (any freely available structure drawing softwares)
  6. Draw the structure of molecules using above mentioned software.
- (Take prints and paste in the physical chemistry record)

B.Sc. Chemistry Programme Laboratory Course  
Semester VI Organic Chemistry Experiments Core Course-XIII Credit-3 Course Code CHI644  
(Lab Course IV),  
and Course Code CHI645 Gravimetry Core Course-XIII (Lab  
Course V) Six hours examination in semester VI

#### I. Organic Chemistry Practicals (micro scale) 1.Tests for

elements : Nitrogen, halogens and sulphur

2. Determination of physical constants
3. Studies of the reactions of common functional groups using known organic compounds.
4. Qualitative analysis with a view to characterization of the functional groups. The following compounds may be given for the analysis : chlorobenzene, benzyl chloride, phenol, o – m – p – cresols, naphthols, resorcinol, benzaldehyde, acetophenone, benzophenone, benzoic, phthalic, cinnamic and salicylic acids, ethyl benzoate, methyl salicylate, benzamide, urea, aniline, o – m, p – toluidines, dimethylaniline, nitrobenzene, o – nitro toluene p – nitro toluene, m – dinitrobenzene, naphthalene, anthracene, glucose and sucrose.

Organic preparations involving halogenation, nitration, oxidation, reduction, acetylation benzoylation, hydrolysis and diazotisation (TLC of the reactant and Product) . Isolation of an organic compound from a natural source eg. Hippuric acid from cow's urine.

5. Chromatography
  - a. Paper chromatographic separation of mixture of nitroanilines, amino acids and sugars
  - b. Separation of a mixture of dyes by column chromatography.
6. Organic estimation
  - a. Molar mass determination of an acid and base by titration method
  - b. Determination of the phenol/aniline by bromate – bromide method
  - c. Determination of the equivalent mass of an ester

## II Gravimetry

The following determinations are to be done using silica crucible (1) Ba as  $\text{BaSO}_4$  (2) Sulphate as  $\text{BaSO}_4$  (3) Iron as  $\text{Fe}_2\text{O}_3$  (4) Calcium as  $\text{CaCO}_3$  (5) Aluminium as  $\text{Al}_2\text{O}_3$  and Magnesium as  $\text{Mg}_2\text{P}_2\text{O}_7$

The following determinations are to be done using sintered crucible

(1) Magnesium as oxinate (2) Nickel using dimethyl glyoxime (3) Copper as copper thiocyanate and (4) Silver as silver chloride

Colorimetry (Using photo electric colorimeter)

Determination of Iron using thiocyanate and ammonia using Nessler's reagent.

## REFERENCE

1. A.I.Vogel, "A text book of Qualitative Analysis including semi micro methods" Longmans.
2. V.V.Ramanujam, "Semi micro Qualitative Analysis"
3. E.S.Gilreath "Qualitative Analysis using semi micro method" Mc Graw Hill
4. A.I.Vogel, "A text book of Qualitative Inorganic Analysis" Longmass
5. A.I.Vogel, "Elementary Practical Organic Chemistry" Longmass
6. Day and Raman, "Laboratory Manual of Organic Chemistry". Viswanathan
7. Mann and Saunders, "Practical Chemistry"
8. A.Findlay, "Practical Physical Chemistry"
9. R.C.Das and E.Behara, "Experimental Physical Chemistry", Tata Mc Graw Hill
10. N.K.,Vishnu, "Advanced practical organic chemistry" Vikas publishing house, New Delhi

The practical examinations of Lab course II ( volumetric analysis), Lab course III ( physical chemistry experiments) and Lab course IV ( organic analysis) , Lab course V ( gravimetric analysis are conducted at the end of VI semester with a duration of two days ( 6hours duration on each day).

First Degree Programme  
Semester V and VI  
Chemistry Project and Factory visit  
Course Code – CH1646  
No. of credit – 4 . Total ESE marks-100- ( No CE marks)  
Project

Aim of the course

To develop an aptitude for research in chemistry, to learn research methodology and literature search

Objective of the course

To inculcate proficiency to identify appropriate research topic and presentation

Specifications

Topics of chemical interest can be selected for the project. Project is to be done by a group not exceeding 5 students. Every student should submit typed (A4 paper, 12 Font, 1.5 Space, 20- 30 pages), spirally bind project report duly attested by the supervising teacher and the Head of the Department on

the day of practical examination before a board of two Examiners for ESE. The viva-voce based on the project is conducted individually. Project topic once chosen shall not be repeated by any later batches of students. List of projects submitted year wise is to be maintained in a register and submitted before the examiners if requested.

The project report may contain the following sections:

1. Preliminary (Title page, declaration, certificate of the supervising teacher, content etc.)
2. Introduction with relevant literature review and objective
3. Materials and Methods
4. Results
5. Discussion
6. Conclusion / Summary 7. References.

Study tour and Factory/ research institute visit

Students are directed to visit one research institute/ chemical factory preferably within the state of Kerala. Scientifically prepared hand written study tour report along with photographs of candidate at the places of visit must be submitted by each student for ESE on the day of the examination of project evaluation.

The board of examiners can decide the scheme of evaluation of project, study tour report and viva voce

Open Course for Other Majors-  
Semester-5 Credit-2 Course-CH1551.1  
2017 admission onwards  
Essentials of Chemistry

Module 1: Atomic structure and Periodic Classification of Elements (9hrs) Structure of atom- Fundamental particles, atomic mass, atomic number, isotopes. Bohr theory of atom. Orbitals- Quantum numbers, aufbau principle, Hund's rule; Pauli's exclusion principle. Electronic configuration of atoms - half and completely filled orbitals. Modern periodic table: Periods, Groups, Periodicity- valency, atomic radius, electronegativity, ionisation potential, Electron affinity.

Module 2 : Nuclear Chemistry

(9 hrs)

Natural radioactivity, Nature and types of radiations, Properties. Group displacement law. Radio active decay series. Decay rate. Half life period, Average life period, Unit of radioactivity. Radiation dose, artificial radioactivity, nuclear structure. Nuclear fission and Nuclear fusion. Rock dating- Radio carbon dating. (elementary idea only)

Module 3 : Polymer Chemistry (9 hrs)

Classification of polymer: Origin, structure, synthesis, Molecular forces. Commercially important polymers: Application of polyethylene, polystyrene, polyhaloolefines, Nylon-6, Nylon-66, Melamine, Terylene, Bakelite, Natural and synthetic rubber, vulcanization, inorganic polymer: (Examples Only).

Module 4 : Chemistry in Biological Process

(9hrs)

Vitamins: Vitamin-A, Vitamin-B2, Vitamin-C, Vitamin-D, Vitamin-E and Vitamin-K- Name, Source, Function and deficiency diseases. Enzymes- Classifications, characteristics, role, examples. Hormones - Sex hormones- Androgens, oestrogens, progesterone, Example, function. Cortical hormones- A few examples

with function. Nucleic acid- RNA, DNA: Introduction- role in life process (No structure or chemical reactions needed)

Module 5 : Chemistry in action ( 9hrs)

Dyes: classification based on constitution, application, examples, uses. Drugs: Antipyretic, analgesic, antiseptic, disinfectants, tranquilisers, antibiotics structure, name and uses only. Soaps and detergents: Hard and soft soaps, anionic, cationic and non-ionic detergents, cleansing action of soaps, Explosives: TNT, TNG, RDX, Gun cotton: name, structure and action. (No structure or chemical reactions needed)

Module 6 :Environmental Chemistry ( 9hrs)

Air Pollution: Types of pollutant in air- carbon monoxide, carbon dioxide, Nitrogen oxides, Sulphur dioxides, hydrogen sulphide, Cl<sub>2</sub>, CFC, particulate matter, metals, fly ash, asbestos, hydrocarbons- source and influence. Acid rain, Green house effect, ozone layer and its depletion. Water Pollution: Various factors affecting purity of water, sewage water, industrial waste, agricultural pollution such as pesticides, fertilizers, detergents. Hard and soft water, Removal of hardness, disadvantage of hard water. Soil pollution : Due to pesticides, herbicide, fungicide, long term use of fertilizers, plastic waste.

References

1. M. C. Day and J. Selbin, "Theoretical Inorganic Chemistry".
2. H. S. Arniker, "Essentials of Nuclear Chemistry".
3. B.K. Sharma "Environmental Pollution".
4. Solomons- John- Wiley, "Fundamentals of Organic Chemistry".
5. F.A. Carey, Mc. GrawHill, "Organic Chemistry" Inc. 226
6. I.L Finar, "Organic Chemistry", Vol. 1 Longman
7. Tewari, Mehrotra- Vikas&Vishnoi, "A Text book for Organic Chemistry".
8. M.K. JainJain, "Principles of Organic Chemistry".
9. A.K. Dey, "Environmental Chemistry".

University of Kerala  
Model Question Paper  
2017 admission onwards  
Open Course for other Majors Course CH1551.1  
Essentials of Chemistry

Time: 3 Hrs

Total marks: 80

Section A.

Answer all the questions. Each question carries 1 mark

1. Who discovered radioactivity?
2. Name any unit of radioactivity. 3. What is the expansion of DNA?
4. Write an example of a sex hormone.
5. Name an enzyme.
6. State Aufbau principle.
7. Draw Px orbital.

8. Give an example of inorganic polymer.
9. Name any compound which causes acid rain.
10. What is the monomer of nylon-6,6?

(1x10 = 10 marks)

### Section B

(2 marks each), Short answer Answer any 8 questions

11. Name the pollutants in air?
12. What are the factors affecting the purity of water?
13. Explain Hund's rule of maximum multiplicity with an example.
14. Define electron affinity, explain with an example.
15. Distinguish between half life period and average life period.
16. Explain artificial radioactivity.
17. Write the structure and applications of polyhalo olefins.
18. What is vulcanization of rubber?
19. What are corticosteroidal hormones? Explain with example.
20. Distinguish between DNA and RNA.
21. How are dyes classified?
22. Explain cleansing action of soap

(2x8 = 16 marks)

### Section C

(Each question carry 4 marks), (Short essay) Answer any 6 questions

23. Explain the source and hazards of fly ash and asbestos.
24. Explain briefly soil pollution.
25. What are periods and groups in the periodic table? What is periodicity?
26. Explain Bohr model of atom.
27. Distinguish between nuclear fission and nuclear fusion with examples.
28. What are Nylon 66, Melamine and Terylene?
29. What are the functions and deficiency diseases of Vitamin C, Vitamin D and Vitamin E.
30. Write a note on explosives.
31. Distinguish between addition and condensation polymerization.

(4x6 = 24 marks)

### Section D

(15 marks each), (essay), Answer any two question

32. a) What are quantum numbers? Explain.  
 b) State Pauli Exclusion Principle. Explain their significance.  
 c) Explain stability of half-filled and completely-filled orbitals. (5x3 = 15 marks)
  
33. a) Write a note on Group Displacement law and radioactive decay series.  
 b) What is carbon dating? In an archaeological piece of wood  $^{14}\text{C}$  activity is 10 % of the activity found in a fresh wood. Calculate the age of the archaeological piece (half life of  $^{14}\text{C}$  is 5760 years.).  
 c) Write a note on vitamin deficiency disease. (5x3 = 15 marks)



34. a) What are the different methods for the analysis of oils and fats?  
 b) What is meant by DNA? Name the sugar unit present in DNA.  
 c) Write a note on vat dyes. (5x3 = 15 marks)
35. a) Explain the cleansing action of soap.  
 b) What is antibiotic? Give the names of the first antibiotic and the scientist who discovered it.  
 c) Give an account of the green house effect. (5x3 = 15 marks)

Open Course For Other Majors-  
 Semester-5 Credit-2 Course Code-CH1551.2  
 2017 admission onwards  
 Fundamentals of Chemistry & Its Application to Everyday Life

Module 1 Evolution of Chemistry 9 hrs

Evolution of Chemistry - ancient speculations on the nature of matter, early form of chemistry alchemy, Robert Boyle and the origins of modern chemistry in the latter 1600s - origin of modern chemistry - Antoine Lavoisier and the revolution in chemistry - Role of Chemistry as a central science connecting Physics, Biology and other branches of science. Basic ideas of interdisciplinary areas involving Chemistry

Module 2 Atomic structure Atom- model of Dalton- Thomson – Rutherford and Bohr. Nature of electron proton and neutron – atomic number – mass number- isotopes -state the relative charges and approximate relative masses of a proton, a neutron and an electron - describe, with the aid of diagrams, the structure of simple atoms as containing protons and neutrons (nucleons) in the nucleus and electrons arranged in shells (energy levels) (no knowledge of s, p, d and f orbitals);

Module 3–Periodic table 9 hrs

The Periodic Table - Periodic trends, Group properties - describe the relationship between group number and the ionic charge of an element- similarities among the elements in the same group - metallic to non-metallic character from left to right across a period of the Period Table- Properties of elements in Group I and XVII using the Periodic Table

Module 4 Structure and properties of materials 9 hrs

Elements, compounds and mixtures – elementary idea of ionic bond and covalent bond- compare the structure of simple molecular substances, e.g. methane; water, carbon dioxide, iodine, with those of giant molecular substances, e.g. poly(ethene); sand (silicon dioxide); diamond; graphite in order to deduce their properties compare the bonding structures of diamond – graphite, electrical conductivity.

Module 5 Chemicals used in everyday life. 9 hrs

Household materials – Major chemical ingredients (No structural formula and preparation needed), method of action and possible hazards/toxicity of : Match Box- Household bleach – Soap- detergent— cooking gas – tooth paste – shampoo-hair dye- nail polish- whitener-moth balls –fire crackers.

Module 6 Chemicals in food and beverages

9 hrs

Important chemical ingredients/ taste makers used in packed food - soft drinks - and its health hazards. Chemicals in food production - fertilizers used in natural sources - Fertilizers urea, NPK and Super phosphates - uses and hazards. Adulterants in milk, ghee, oil, coffee powder, tea, asafoetida, chilli powder, pulses and turmeric powder - identification. artificial sweeteners - food preservatives.

University of Kerala  
Model Question Paper  
2017 admission onwards  
Open Course for other Majors Course  
Semester V Course Code CH1551.2 Credit 2  
Fundamentals of Chemistry & Its Application to Everyday Life Time:  
Three Hours Maximum Marks : 80

Section A

(answer in a word / sentence) Answer all

questions 1. What is superphosphate?

2. Who is the Father of Modern Chemistry? 3. How many atoms are present in a molecule of ozone?

4. Define isotopes.

5. What is a diamond made up of?

6. Which element has the electron configuration 2,1.

7. Name a liquid element.

8. What is the shape of water molecule? 9. How many valence electrons are there in carbon?

10. Name the main compound present in cooking gas.

Section B

Each question carries 2 marks (Short answer type). Answer any eight questions .

11. Name any two Toxic Chemicals in Cosmetics

12. Obtain the electron configuration for (a) N; (b) F.

13. Explain Hund's rule of maximum multiplicity with an example.

14. Define electron affinity, explain with an example.

15. Which of the following elements Li, Be, B, C, N, O, F and Ne are metals?

16. Explain Bohr model of atom.

17. Why is the electronegativity value of most noble gases equal to zero?

18. What are the Health Effects of Drinking Soda?

19. Which do you expect to have more metallic character, Lead (Pb) or Tin (Sn)
20. What is a Match Head of match stick made of?
21. Explain why graphite conducts electricity whereas diamond doesn't.
22. Is the reactivity of group I metals increasing or decreasing down the group? Explain why?  $2 \times 8 = 16$

#### Section C

Each question carries 4 marks (Short essay type) Answer any six questions

23. Explain the colour of firecrackers.
  
24. What is the difference between covalent and ionic bonding?
25. What are periods and groups in the periodic table? What is periodicity?
26. What are adulterants.
27. How is Thomson's model of the atom different from Dalton's model of atom?
28. What's the difference between an oxidation number and an ionic charge?
29. Explain the health hazards associated with drinking soft drinks?
30. How can metallic character change across a period?
31. Describe clearly the link between increasing effective nuclear charge across a period and the changes in van der Waals radius.

$4 \times 6 =$

#### Section D

Each question carries 15 marks (essay type) Answer any two questions.

32.
  - a. Explain about the pH changes of aqueous solutions of elements in the third period as the period is crossed.
  - b. Explain how these changes are directly related to the changes in effective nuclear charge across the period.
  - c. Describe the metallic character of elements in a period.
  
33.
  - a. Explain the role of some chemicals in household items. (7.5 marks)
  - b. Write a short note on food adulteration. (7.5 marks)
  
34.
  - a. Write a short note on the uses and hazards of fertilisers. (10 marks)
  - b. Draw the structure of carbon and sodium containing nucleons. (5 marks)
  
35.
  - a. Compare the structure of substances, methane, water, carbon dioxide and iodine, with ethane and silicon (10 marks)
  - b. Compare the bonding structures of diamond – graphite. (5 marks)

- Module -I Environmental Components: 9 hrs  
 Structure and composition of the, Atmosphere, hydrosphere, biosphere and Lithosphere – composition of atmosphere
- Module -II Water pollution: 9 hrs  
 Sources, its effect and control; Sampling and measurement of water quality and their analysis, water quality standards, BOD and COD Hard water – soft water Eutrophication and restoration of lakes.
- Module -III Air Pollution: 9 hrs  
 Types and sources of air pollution, Common Air Pollutants - Effects of air pollution; Smog – ozone layer depletion – green house effect – acid rain
- Module -IV Soil Pollution: 9 hrs  
 Sources, types, effects and control of: Land pollution, Marine pollution, Thermal Pollution and Radioactive pollution. Waste separation, storage and disposal ; Waste Reduction, Recycling and Recovery of materials. Plastics and their misuses.
- Module -V Major environmental disasters 9 hrs  
 Major environmental disasters - - mercury poisoning in Minamata, Japan ,Itaitai disease due to cadmium poisoning in Japan - Love Canal toxic waste site, Seveso disaster chemical plant explosion - Bhopal disaster - Chernobyl incident,
- Module -VI Major environmental laws: 9 hrs  
 Environment (Protection Act) – The Air (Prevention and control of pollution) Act – The water (Prevention and control of pollution) Act – The wild life protection Act – Forest conservation Act – The Ozone Depleting Substances (Regulation and Control) Rules – The Plastic Waste (Management and Handling) Rules - Rio declaration- Montreal protocol, Kyoto protocol Introduction to Green chemistry (elementary ideas only)

#### Reference

1. S. K. Banerji, "Environmental Chemistry".
2. K. De "Environmental Chemistry - An introduction"
3. B. K. Sharma "Air Pollution".
4. V. K. Ahluwalia "Environmental Chemistry"
5. G.W. vanLoon and S. J. Duffy "Environmental Chemistry: A global perspective"
6. S.K.Mohanty, Environment and Pollution Laws, Universal Law Publishing Co. Pvt Ltd

University of Kerala  
Model Question Paper  
2017 admission onwards  
Open Course for other Majors Course Code CH1551.3 Credit -2  
Environmental Chemistry

Time: 3 hours

Maximum marks: 80

Section A

Answer all questions (Each answer carries 1 mark)

1. What do you mean by Triple R in waste management?
2. What type of pollution causes acid rain?
3. What are the misuses of plastics?
4. What are the three major man-made sources of air pollution?
5. What kind of materials are discharged into the seas?
6. What increases the amount of carbon dioxide in the atmosphere?
7. Explain the action of zeolites on hard water.
8. What are freons?
9. Define pollution
10. What is fly ash

(10x1=10) Section

Section B

(short answer type) (Answer any 8 questions, Each answer carries 2 mark)

11. How is pollution related to acid rain?
12. How does ocean pollution affect sea animals?
13. What are the main concepts of Green Chemistry?
14. Write short note on Radioactive pollution
15. Discuss the major composition of earth's atmosphere
16. Write about the cause and consequence of Chernobyl incident
17. What is BOD and COD?
18. What causes radioactive pollution?
19. Distinguish between Hard water and soft water.
20. What is the goal of Forest Conservation Act?
21. What is the Greenhouse effect and what is its cause?
22. What are the types of air pollutants?

(2x8 = 16)

Section C

(Short essay type) each question carries 4 marks. Answer any 6

23. Write short note on volatile organic compounds.
24. How can thermal pollution be prevented?
25. How do you control Radioactive pollution?
26. What is smog? How does smog arise?

27. What is Eutrophication
28. Write a note on Rio-Declaration.
29. Explain the various layers of the Atmosphere
29. What is Air Pollution? How can air pollution be minimized?
30. Briefly explain about the components of atmosphere.

6×4 = 24

Section D.

Answer any 2 from the following. Each question carries 15 marks

32. (a) Explain Hardness of water and the different types. (5 marks) (b) Discuss about the various sources of water pollution. (5 marks)
- (c) What are the control measures for water pollution ? . (5 marks)
33. (a) Write short note on causes and problems of ozone layer depletion? (b) Explain the various types of smog.
- (c) Discuss the Ozone Depleting Substances (Regulation and Control) Rules
34. (a) Explain thermal pollution
- (b) Discuss about plastics and their misuses
- (c) Discuss about Chernobyl disasters
35. (a) Discuss about green chemistry
- (b) Explain Montreal protocol and Kyoto protocol
- (c) The water (Prevention and control of pollution) Act

15 × 2= 30

B.Sc. Chemistry programme Elective Course  
Semester-6 Credit-2 Elective Course, Course Code – CH1651 .1  
Supramolecular, Nano Particles and Green Chemistry---54 hrs

Module I Green Chemistry-1 ---9hrs

Role of Chemical Industries in polluting the environment-Limitations of conventional waste management-pollution prevention-birth of green chemistry-introduction to the principles of green chemistry-atom economy calculation(simple reactions)-production of Ibuprofen-less hazardous chemical syntheses, designing safer chemicals-Bhopal gas tragedy- new greener syntheses, safer solvents and auxiliaries ionic liquids-super critical fluids CO<sub>2</sub> and H<sub>2</sub>O, advantages of SCFs

Module II Green Chemistry-2 ---9hrs

Design for energy efficiency-principle of microwave oven, microwave assisted organic syntheses, simple examples- renewable feedstock- biodiesel, preparation, advantages, catalysis, green catalysts- inherently safer chemistry for accident prevention. Green chemistry practices in research, educational and commercial laboratories- lab safety signs- introduction to micro scale experiments.

Module III Chemistry of Nano Materials Part I

9 Hrs

Classifications of nanostructured materials, nano particles; quantum dots, nanowires, ultra - thinfilms-multilayered materials. Synthesis of nanometre scale particles of colloidal semiconductors such as TiO<sub>2</sub>, CdS, ZnO, BaTiO<sub>3</sub>, by wet chemical methods, hydrothermal methods, and pyrolytic or high temperature methods. Carbon nanotubes fullerenes and graphene. Synthesis and purification of carbon nanotubes, Singlewalled carbon nanotubes and multiwalled carbon nanotubes, Structure-property relationships.

#### Module IV Chemistry of Nano materials Part II

9 hrs

Preparation of self-assembled monolayers, core shell nanoparticles and quantum dots. Properties of nanoparticles: optical, magnetic, mechanical, thermal and catalytic properties, characterisation of nano particles by AFM, STM and SEM. Applications of nanomaterials: Potential uses of nanomaterials in electronics, robotics, computers, sensors, mobile electronic devices, vehicles and transportation. Medical applications of nanomaterials.

#### Module V :Molecular recognition

9hrs

The concepts of molecular recognition, host, guest and receptor systems. Forces involved in molecular recognition. Hydrogen bonding, ionic bonding, p-stacking, vander Waal's and hydrophobic interactions.

#### Module VI Supramolecular chemistry:

9hrs

Introduction to molecular receptors-design principles: Tweezers, Cryptands and Carcerands, Cyclophanes, Cyclodextrins and Calixarenes- Typical examples Molecular recognition and catalysis- catalysis by cation receptors, anion receptors and cyclophanes.  
Molecular recognition in DNA and protein structure

#### References

1. Anastas. P.T.; Warner, J.C., "Green Chemistry; Theory and Practice", Oxford University Press; Oxford , U.K.,1998.
2. Lancaster,M, "Green Chemistry; An Introductory Text", Royal Society of Chemistry; Cambridge,UK, 2003
3. Rashmi Sanghi and M.M Srivasthava, "Green Chemistry Environment Friendly Alternatives", Narosa Publishing House,2006
4. T.Pradeep, "NANO: The Essentials", 'McGraw-Hill Education'. 5. D. Nasipuri "Stereochemistry of Organic Compounds", Wiley
6. J M Lehn, "Supramolecular Chemistry", V C H.
7. H Vogtle, "Supramolecular Chemistry", W iley.
8. P S Kalsi, J P Kalsi, "Bioorganic, Bioinorganic and supramolecular Chemistry", New Age International

University of Kerala  
Model Question Paper  
2017 onwards

B.Sc Chemistry Programme  
Elective Course Semester VI Course Code CH1651.1 Credit 2  
Supramolecular, Nano Particles and Green Chemistry

Time: Three Hours

Maximum marks : 80

Section A.

Answer all questions. Each question carries 1 mark.

1. Define atom economy.
2. Write an example of green catalyst.
3. Between an addition and elimination reaction which is having a better atom economy?
4. Name a colloidal semiconductor.
5. Expand SAMS.
6. What is graphene?
7. Name the different allotropes of carbon.

- 8 . Name any two molecular receptors.
- 9.What are cryptands?
10. Define  $\pi$  stacking.

Section B.

Answer any eight questions. Each question carries 2 marks.

11. Write a note on Bhopal Tragedy.
12. Define Carbon efficiency.
13. Explain the limitations of conventional waste management.
14. Give any four lab safety signs with its meaning.
15. Write about the wet method of preparing colloidal semiconductors.
16. What are the magnetic properties of nanoparticles.
17. Briefly describe the catalytic properties of nano materials.
18. Explain the different types of SWCNTs.
19. What are the non-covalent bonds involved in molecular recognition?
20. Define host and guest in supramolecular chemistry.
21. Write a note on Cyclodextrins.
22. What are molecular tweezers?

Section C.

Answer any six questions. Each question carries 4 marks.

23. What are secondary electrons?
24. Write a note on safer solvents and auxiliaries.
25. Explain ionic liquids.
26. Write a note on biodiesel.
27. Describe the synthesis of quantum dots and mention its optical properties.
28. Explain the preparation of SAMs.
29. Discuss the potential applications of nanomaterials in computers, sensors, and Medical applications.
30. Discuss the various aspects of molecular recognition involved in the structure of DNA.
31. Write notes on cation and anion receptors.

Section D

Answer any two questions. Each question carries 15 marks.

32. (a) Explain the twelve principles of green chemistry. (10 marks)
- (b) Explain microwave assisted organic syntheses with an example. (5 marks)
33. (a) Explain the principle and working of SEM
- (b) Write a note on synthesis and purification of carbon nanotubes.
34. Write short notes on (a) calixarenes (b) Cyclodextrins (c) cyclophanes.
35. Write short notes on (a) molecular recognition (b) preparation biodiesel (c) non bonded interactions.

B.Sc Chemistry Programme ELECTIVE  
COURSE

Semester-6 Credit-2 Course Code – CH1651.2  
Computational, Combinatorial and Physical Organic Chemistry 54 hrs

Module I Introduction to Computational Chemistry

9 hrs

Web resources in chemistry learning Introduction to structure drawing, spread sheet and chemistry related softwares. Approximate methods in Quantum mechanics- Many electron atoms: Self consistent field method. Chemical bonding: Perturbation theory and variational principle. MO theory of hydrogen molecule ion. VB theory of hydrogen. Concept of resonance.



## Module II Computational Methods

9 hrs

Brief description of computational methods: ab initio, semi empirical, DFT and molecular mechanics. RHF, ROHF & UHF methods Basis sets, STO & GTO. Z-matrix of simple molecules H<sub>2</sub>O, CO<sub>2</sub> & NH<sub>3</sub>. Common computational and visualization softwares

## Module III: Combinatorial Chemistry Introduction

9 hrs

Early development, what is combinatorial synthesis, library synthesis on resin beads, solid phase chemistry, Merrifield peptide synthesis, support for solid phase synthesis, parallel synthesis and mix and split library synthesis.

## Module IV Combinatorial Synthesis

9hrs

Libraries on multipins, libraries on wicks, libraries on laminar solid phases (no detail study). Solution phase library synthesis- eg., Hantzsch synthesis of aminothiazole, peptide and nonpeptide libraries( eg. only), Applications of combinatorial chemistry in drug discovery.

Module V : Introduction to Physical organic chemistry 9 hrs Classification of mechanism with suitable examples. Bond breaking mode – Heterolytic, Homolytic and Pericyclic Nature of reaction – Substitution, Elimination, Addition, Pericyclic and Rearrangement reactions. Nature of reagent – Nucleophilic, Electrophilic and Free radical. Thermodynamic and Kinetic control of reaction. The Hammond postulate (qualitative treatment). The thermodynamic functions –  $\Delta H$ ,  $\Delta S$  and  $\Delta G$  and their determination from Arrhenius equation. Role of above thermodynamic functions in mechanistic probe of reactions. Methods of determining mechanism, Identification of products, Detection of intermediates, Catalytic study, Isotopic labeling, Stereochemical evidence, Kinetic evidence.

## Module VI Correlation of structure with reactivity

9 hrs

The effect of substrate structure – Differences in mechanism for primary, secondary and tertiary systems. The effect of  $\alpha$  and  $\beta$  substitution – the +I and –I effects (Inductive effects of electron releasing and electron withdrawing groups at  $\alpha$  and  $\beta$  positions). Substitution of mono and bicyclic (at  $\alpha$  and  $\beta$  positions) aromatic rings (Resonance effects). Hyperconjugate effects. Neighbouring group effect nonclassical bridge head - Steric effects – B-strain, Strain in aliphatic cyclic systems. Steric inhibition of resonance – ortho effect and  $\alpha$ -effect, The Hammett equations.

## References :

1. Guy H. Grant and W.Graham Richards, "Computational Chemistry", OCP(29) 2. Christopher J. Cramer, John Wiley, "Essentials of Computational Chemistry",
3. Frank Jensen, "Computational Chemistry".
4. Ira N. Levine, "Quantum Chemistry".
5. David Young, "Computational Chemistry A Practical Guide for Applying Techniques to Real World Problems", Wiley Interscience.
6. N K Turret, "Combinatorial Chemistry", (Oxford Publication)
7. Jerry March "Advanced Organic chemistry", 3rd edition, Wiley International (Indian edn New Delhi) Chapter 6 and 10
8. P S Kalsi, "Text of organic Chemistry", Mac millan India Ltd 1999 Ch 2
9. M K Jain and S C Sharma, "Modern Organic Chemistry", Vishal Publishing Co, 2004, Chapter 3,4, 15

UNIVERSITY OF KERALA  
B.Sc Chemistry Programme, Semester VI  
2017 admission onwards  
MODEL QUESTION Elective Course- Course Code CH1651 .2 Credit 2 Computational,  
Combinatorial and Physical Organic Chemistry Time: Three Hours  
Max. Marks : 80

Section A

Answer all questions. Each question carries 1 mark.

1. Write Arrhenius expression and explain the terms.
2. What is RHF?
3. What are nucleophilic reagents? Give examples.
4. Name any two structure drawing softwares.
5. Write Hammett equation.
6. Give one example solution phase library synthesis.
7. Write any two examples for poly amide resin.
8. Propene is more stable than ethane. Why?
9. What is combinatorial synthesis?

10. Write any two examples for heterolytic bond breaking reaction. 1 X 10 = 10 Marks  
Section B  
Answer any eight questions from the following. Each question carries 2 marks.

11. What are the web resources in learning Chemistry?
12. What is a basis set ?
13. What are the major mechanisms of organic reactions ?
14. Distinguish between STO & GTO.
15. Explain the advantages of combinatorial synthesis.
16. What is meant by electrocyclic reaction. Give one example.
17. What are the applications of combinatorial synthesis.
18. What are multipins used in combinatorial synthesis
19. Explain kinetic requirements of reaction.
20. Explain Hammond postulate.
21. Explain +I and -I effects.

22. Explain isotopic labeling in the study of organic reactions. 2 x 8 = 16  
Section C

Answer any six questions from the following. Each question carries 4  
marks.

23. Draw the Z matrix of H<sub>2</sub>O & NH<sub>3</sub>
24. Why SEM is called parametrisation method
25. How can a eight – member dipeptide library is synthesized ?
26. Explain non-peptide libraries.
27. How are the intermediates detected?
28. Explain substitution reactions of naphthalene.
29. Explain the effect of leaving group in aliphatic substitution reactions.
30. What is self consistent field method.
31. Explain mix and split library synthesis. 6 X 4 = 24 Marks

Section D

Answer any two questions from the following. Each question carries 15 marks

32. (a) Explain MO theory of hydrogen molecule ion. (b) Explain VB theory of hydrogen .  
10 + 5 = 15 Marks
33. (a) Explain neighboring group participation with examples. (b) Explain steric effects and B-strain.  
7.5 + 7.5 = 15 Marks
34. (a) How does the structure of substrate affect the aliphatic nucleophilic substitution? (b) Comment on the effect of substituent on nucleophilic substitution reaction.  
7.5 + 7.5 = 15 Marks
35. (a) Write a brief description of methods (a) ab initio (b) DFT (c) molecular mechanics.  
5 + 5 + 5 = 15 Marks

B.Sc Chemistry Programme  
ELECTIVE-COURSE  
2017 admission onwards  
Semester-6 Credit-2 Elective Course Code - CH1651.3  
POLYMER CHEMISTRY 54hrs

Module I:- Introduction

9hrs

Brief history of macromolecular science, general characteristics of polymers in comparison with common organic compounds. Nomenclatures. Distinction between plastics, elastomers and fibres. Natural polymers- cellulose, silk, gums and resin . Types of polymers- thermoplastics and thermosettings, functionality concept. Concept of cross linked polymers. Types of polymerization- addition, condensation, ionic, co-ordination. Addition – polymerisation – mechanism, initiation , propagation and termination processes, initiators, inhibitors. Mechanism of ionic polymerization

Module II : Methods of polymerization

9hrs

Methods of polymerization-bulk, suspension, emulsion, solution necessity of copolymers and copolymerization, blocks and graft copolymers. Detailed study of the following thermosetting polymers with respect to synthesis, chemistry, properties and applications. (a) phenol- formaldehyde resins (b) amino resins\_ urea- formaldehyde and melamine-formaldehyde resins (c) polyurethanes (d) epoxy resins- grades of epoxy resins, curing process and its importance with mechanism (e) poly carbonates, silicones

Module III: : Elastomers-I

9hrs

Polyisoprene, polybutadiene, neoprene. Detailed study of the following thermoplastic polymers with respect to synthesis, chemistry, properties and applications. Polyolefins ,polyethylenes\_HDPE, LDP,LLDP, polyvinyl chloride-grades of PVC, Teflon, Polystyrene-homopolymers, copolymers such as SBR, ABS, SAN.

Module IV : Elastomers 2

9hrs

Vinyl polymers- polyvinyl acetate and its modifications like PVA, PVB and polyacetals. Polyamides - nylon -6, nylon-66 and other nylons. Poly ethers and poly esters, terephthalates. Cellulosics such as esters, ethers, acetates, butyrates, nitrate, CMC; regenerated cellulose.

Module V: Experimental methods-1

9hrs

Molecular weight and molecular weight distribution – number , weight and viscosity average molecular weights of polymers, methods of determining molecular weight, practical significance of

molecular weight distribution, size of polymers. Introductory concepts of kinetics of polymerization and Carother's relation. Glassy state, glass transition temperature, TGA, factors affecting GTT, crystallinity in polymers.

#### Module VI : Experimental Methods –II

9hrs

Viscosity, solubility, optical properties, electrical properties, thermal properties, mechanical properties of polymers. Degradation of polymers by thermal, oxidative, mechanical and chemical methods. Polymer processing- compression moulding, casting, extrusion, fibre spinning, injection moulding, thermoforming, vulcanization of elastomers, polymer industry in India.

#### References

1. Billmeyer, "Textbook of polymer science", John Wiley and Sons
2. D.D. Deshpande, "Physical chemistry of macromolecules", Vishal publications, New Delhi, 1985
3. V.R. Gowariker, N.V. Viswanathan and J.Sreethan, "Polymer Science", Wiley Eastern Ltd, 1986

B.Sc Chemistry Programme  
Model Question Paper  
Elective Course Semester VI Course Code CH1651.3  
2017 admission onwards  
Polymer Chemistry

Time: Three Hours

Maximum Marks: 80

#### Section A

Each question carries 1 mark (Answer in one word/sentence)

Answer all questions

1. What are elastomers?
2. How is melamine-formaldehyde resin prepared?
3. Write a note on Nylon 66.
4. Mention the monomer unit of neoprene.
5. Define copolymers.
6. Explain extrusion.
7. Define fibre spinning.
8. Explain emulsion polymerisation
9. Give two examples of natural polymers
10. What is SBR and SAN?

#### Section B

Answer any eight questions. Each question carries 2 marks.

11. Write a note on Condensation polymerisation.
12. Explain the synthesis of HDPE.
13. Write a note on Polyurethanes.
14. Explain number, weight and viscosity average molecular weight.
15. Define graft copolymers.
16. Explain the preparation of PVC.
17. What are epoxy resins?

18. Explain the vulcanisation of elastomers.
19. Write the mechanism of ionic polymerisation.
20. Explain the chemical methods of degradation of polymers.
21. Explain polymer processing.
22. Distinguish between thermoplastics and thermosetting plastics.

#### Section C

Answer any six questions. Each question carries 4 marks.

23. Write a short note on silicones?
24. What are the methods of determining molar mass?
25. Write notes on (1) compression (2) moulding (3) casting
26. Discuss the synthesis and application of Teflon
27. Describe the role of initiators and inhibitors in addition polymerisation
28. Distinguish between plastics, elastomers and fibres
29. Describe the TGA of polymers.
30. Discuss the various aspects of molecular recognition involved in the structure of DNA.
31. Explain kinetics of polymerization and Carothers relation

#### Section D.

Answer any two questions. Each question carries 15 marks.

32. Discuss the methods of (a) Determining molecular weight (b) Practical significance of molecular weight distribution
33. Write a note on (a) vinyl polymers and (b) discuss about the methods of synthesis of PVA, PVB and Polyacetals.
34. (a) Explain crystallinity in polymers (b) Explain thermal, electrical and mechanical properties of polymers.
35. Write notes on (a) compression (b) moulding (c) casting

B.Sc Chemistry Programme Elective Course  
2017 admission onwards  
Semester-VI Course Code –CH1651.4 Credit-2  
Total: 54Hrs

#### BIOCHEMISTRY Module - I Blood

9 Hrs

Constituents of blood cells and plasma, plasma proteins, albumin and globular - lipoproteins, functions (Details not expected), Coagulation - 'Coagulation factors, Hemoglobin - functions, Structure of hemoglobin, abnormal hemoglobin.

#### Module II Respiration

9 Hrs

Chemical and physiological events, affecting diffusion of O<sub>2</sub> and CO<sub>2</sub> during respiration, Transport of Oxygen in Blood O<sub>2</sub> dissociation curve, Interrelationship between O<sub>2</sub> and CO<sub>2</sub> transport.

#### Module III Kidney Function

9 Hrs

Body water balance, buffers in blood, Formation of Urine, Kidney function, Renal Threshold, Constituents of Urine, diseases associated with Kidney function

#### Module IV Nutrition

9 Hrs

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

Module V Digestion and Absorption of Food

9 Hrs

Outline study of digestion and absorption of Carbohydrates, proteins, fats and enzymes involved , composition and functions of bile - Bile pigments, Bile acids, Bile salts.

Module VI Biochemical Techniques

9 Hrs

Chromatography - Ion exchange, adsorption paper, TLC, GLC, affinity, Gel filtration Electrophoresis - paper, gel, ultracentrifugation.

REFERENCES

1. Gyton, "Text Book of Medical Physiology".
2. Ganog, "Text Book of Medical Physiology".
3. David Randall, "Physiology".
4. Dr. A.C. Deb, "Fundamentals of Biochemistry".
5. Swaminathan, "Advanced Text Book on Food & Nutrition".
6. B. Srilakshmi, "Nutrition Science".

University of Kerala  
B.Sc Chemistry Programme  
Model Question Paper  
Elective Course Semester VI Course Code CH1651 .4  
Biochemistry  
2017 admission onwards

Time: 3 hours

Maximum marks: 80

Section A.

Answer all questions (maximum two sentences each question carries 1 mark)

1. What is the normal pH of arterial blood?
2. What is the cause of sickle cell anemia?
3. Give an example for plasma protein.
4. What are anticoagulants?
5. Define BMR?
6. What is the renal threshold value of glucose?
7. What is NPN?
8. What is the calorific value of fat?
9. Name the bile pigments.
10. What is GLC?

(10x1=10

marks)Section B

Answer any eight, each question carries 2 marks

11. Define renal threshold and its significance?
12. What are the normal constituents of urine?
13. What are the different types of hemoglobin?
14. Write a short note on protein digesting enzymes.
15. Draw the structure of heme
16. What are the constituents of blood?
17. What are the functions of plasma protein?
18. What is difference between plasma and serum?

19. What is adsorption chromatography?
20. What is the composition of bile?
21. Write about abnormal hemoglobin.
22. Discuss about ion exchange chromatography.

(8 x 2 = 16 marks)

#### Section C

Answer any six each question each question carries 4 marks

23. Explain Oxygen dissociation curve and factors affecting its shift.
24. Describe gel electrophoresis.
25. Explain thin layer chromatography.
26. Explain briefly the buffers in blood.
27. Give an account of diseases affecting kidney function.
28. Discuss about ultracentrifugation.
29. Discuss the physiological events involved in the transport of oxygen and carbon dioxide.
30. Describe briefly about the various blood cells.
31. Briefly explain about lipoproteins and their functions.

(6 x 4 = 24 marks)

#### Section D

Answer any two ( essay) Each question carries 15 marks

32. Discuss about (i) Coagulation factors (ii) Anticoagulants (iii) Mechanism of blood clotting.
33. Discuss about the principle procedure and applications of (i) SDS PAGE (ii) Affinity chromatography (iii) Gel filtration chromatography
34. Describe (i) Body water balance (ii) Functions of kidney (iii) Formation of urine.
35. Discuss about the digestion and absorption of (i) Carbohydrate (ii) Protein (iii) Fat

(15 x 2 =30 marks)