UNIVERSITY OF KERALA

CAREER RELATED FIRST DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM

SCHEME AND SYLLABI

2010 ADMISSION ONWARDS

Core Courses, Vocational Courses, Foundation Courses, Open Course, Elective Course and Auxiliary Mathematics

FIRST DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

Aim

The First Degree Programme in Chemistry and Industrial Chemistry covers three academic years consisting of six semesters and aims to train the students on basic elements of industrial chemistry namely chemistry with particular relation to chemical industries, current situation of raw materials and energy, products of the chemical industry, the vocabulary of industrial chemical processes, comparison of laboratory scale versus industrial scale reactions, reaction kinetics, mass and heat transfer, thermodynamics, material data, balance equations, costing, flow diagrams, basic organic and inorganic chemicals, polymeric materials and chemical processes used in production, and environmental protection. The syllabus has been designed to stimulate the interest of the students in chemical processes in various industries and has been prepared so as to equip the students with a potential to contribute to the academic and industrial requirements of the society.

Objective

The main objective is to provide to the students an in-depth understanding of the basic concepts of chemistry and how it is applied in industry for the production of bulk materials. This programme enables 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. The student learns the steps and the methodology of the introduction of a simple chemical process developed in the laboratory to an industry.

First Degree Programme in Chemistry and Industrial Chemistry

Table I. 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	
I		English I	5		3	3hrs	25%	75%	17
	ML\HN1111.3	Additional Language I	5		3	3hrs	25%	75%	
	IC 1121	Foundation Course I Methodology and Informatics	2	1	3	3hrs	25%	75%	
	MM1131.7	Mathematics	5		4	3hrs	25%	75%	
	IC 1141	Core Course I-Inorganic Chemistry I	3		4	3hrs	25%	75%	
	IC 1142	Core Course II- Chemistry Lab I		4					
II		English II	5		3	3hrs	25%	75%	20
	ML\HN1211.3	Additional Language II	5		3	3hrs	25%	75%	
	IC 1221	Foundation Course II Methodology of Chemistry II	2		2	3hrs	25%	75%	
	MM1231.7	Mathematics II	5		4	3hrs	25%	75%	
	IC 1241	Core Course III Inorganic Chemistry II	4		4	3hrs	25%	75%	
	IC 1242	Core Course IV-Chemistry Lab II		4	4	3hrs	25%	75%	
III		English III	5		3	3hrs	25%	75%	**17**
	MM1331.7	Mathematics III	5		4	3hrs	25%	75%	
	IC 1371	Vocational Course I Industrial Chemistry I	4		4	3hrs	25%	75%	
	IC 1341	Core Course V-Organic Chemistry I	3		3	3hrs	25%	75%	
	IC 1342	Core Course VI-Physical Chemistry I	4		3	3hrs	25%	75%	
	IC 1372	Vocational Course II Industrial Chemistry Lab-I		2					
	IC 1343	Core Course VII-Chemistry Lab III		2					
IV		English IV	5		3	3hrs	25%	75%	**26**
	MM1431.7	Mathematics IV	5		4	3hrs	25%	75%	
	IC 1471	Vocational Course III Industrial chemistry-II	3		4	3hrs	25%	75%	
	IC 1441	Core Course VIII-Inorganic Chemistry III	4		4	3hrs	25%	75%	
	IC 1442	Core Course IX-Physical Chemistry II	4		4	3hrs	25%	75%	
	IC 1472	Vocational Course IV- Industrial chemistry Lab- II		2	4	3hrs	25%	75%	
	IC 1443	Core Course X- Chemistry Lab-IV		2	3	3hrs	25%	75%	

	IC 1541	Core Course XI-Organic Chemistry II	4		4	3hrs	25%	75%	
	IC 1571	Vocational Course V Industrial Chemistry-III	2		4	3hrs	25%	75%	
	IC 1572	Vocational Course VI Industrial Chemistry IV	2		4	3hrs	25%	75%	**18**
V	IC 1542	Core Course XII- Chemistry Lab-V		6				_	
	IC 1573	Vocational Course VII Industrial chemistry Lab-III		6	4	3hrs	25%	75%	
	1551	Open Course	3		2	3hrs	25%	75%	
	IC1560	Project		2	_	_	_	_	
	IC 1641	Core Course XIII -Physical Chemistry-III	4		3	3hrs	25%	75%	
	IC 1671	Vocational Course VIII -Industrial chemistry-V	2		4	3hrs	25%	75%	**22**
	IC 1672	Vocational Course IX-Industrial Chemistry- VI	2		3	3hrs	25%	75%	
	IC 1642	Core Course XIV- Chemistry Lab-VI		6	2	3hrs	25%	75%	
VI	IC 1673	Vocational Course X- Industrial Chemistry Lab -IV		6	4	3hrs	25%	75%	
	IC 1651.1	Supramolecular, Nano, and Green Chemistry	3		2	3hrs	25%	75%	
	IC 1651.2	Computational, combinatorial and Physical organic chemistry							
	IC 1651.3	Polymer chemistry							
	IC 1651.4	Biochemistry							
	IC 1661	Project		2	4	Viva	_	100%	

1. English -4
2. Additional Language Courses = 2
3. Foundation Courses = 2
4. Complementary Courses = 4
5. Core Courses = 14
6. Vocational course= 10
7. Open Course = 1
8. Elective Course = 1
9. Project = 1
10. Total Courses = 4+2+2+4+14+12+1+1 = 40
11. Total Credits = 17+20+17+26+18+22 =120

The First Degree programme in Chemistry and Industrial Chemistry comprises of 14 core courses, 10 vocational 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, Table V gives the scheme of question paper for Theory Courses, Table VI gives the details of complementary courses in mathematics being offered to Industrial Chemistry and Table VII Gives the consolidation of Grade of a Course.

Table II. Scheme of Instruction of Core Courses, Vocational courses, Foundation Courses, Open Course and Elective Course

Course number	Course Code	Course Title	Semester I			Semester II			Semester III			Semester IV			Semester V			Semester VI			Total	
			Contact Hours		Credit	Contact Hours		Credit	Contact Hours		Credit	Contact Hours		Credit	Contact Hours		Credit	Contact Hours		Credit	Contact Hours	Credit
			T	P		T	P		T	P		T	P		T	P		T	P			
1	IC 1141	Core- Inorganic Chemistry I	3		4																3	4
2	IC 1121	Foundation- Methodology and Informatics	2	1	3																3	3
3	IC 1241	Core- Inorganic Chemistry II				4		4													4	4
4	IC 1221	Foundation Methodology of Chemistry-II				2		2													2	2
5&6	IC 1142&1242	Core Chemistry LabIand II		4			4	4													8	4
6	IC1371	Vocational Industrial Chemistry I							4		4										4	4
7	IC1341	Core- Organic Chemistry I							3		3										3	3
8	IC1342	Core Physical Chemistry I							4		3										4	3
9	IC1471	Vocational –Industrial Chemistry -II										3		4							3	4
10	IC1441	Core- Inorganic Chemistry -III										4		4							4	4
11	IC1442	Core- Physical Chemistry -II										4		4							4	4
12	IC1343 &IC1443	Core- Chemistry Lab III and IV								2		2	3								4	3
13	IC1372 &IC1472	Vocational Industrial Chemistry Lab I and II								2		2	4								4	4
14	IC1541	Core- Organic chemistry II													4		4				4	4
15 16	IC1571 IC1572	Vocational Industrial Chemistry III Vocational Industrial Chemistry IV													2 2		4 4				4	4 4
17	1551	Open Course													3		2				3	2
18	IC1641	Core- Physical Chemistry III																4		3	4	3
19 20	IC1671 IC1672	Vocational Industrial Chemistry V Vocational Industrial Chemistry VI																2 2		3 4	4	4 3
21	IC1651	Elective Course																3		2	3	2
22	IC1542 &IC1642	Core- Chemistry Lab V and VI													6			6		2	12	2
23 24	IC1573 IC1673	Vocational Industrial Chemistry Lab III Vocational Industrial Chemistry Lab IV													6			6		4 4	6 6	4 4
22		Project													2			2		4	4	4

Table III. Scheme of Instruction of
Semester V Chemistry and Industrial Chemistry Open Courses
Offered to students of other disciplines

Semester	Course Code	Course Title	Instructional hours/week	Credits
V	IC1551.1	Essentials of Chemistry	3	2
	IC1551.2	Petrochemicals		
	IC1551.3	Pharmaceuticals		
	IC1551.4	Dyes		

Table IV. Scheme of Instruction of
Semester VI Chemistry and Industrial Chemistry Elective Courses

Semester	Course Code	Course Title	Instructional hours/week	Credits
VI	IC1651.1	Supramolecular, Nano and Green Chemistry	3	2
	IC1651.2	Computational, Combinatorial and Physical Organic Chemistry		
	IC1651.3	Polymer Chemistry		
	IC1651.4	Chemistry		

Table V. Scheme of question paper – Theory Courses

Type of Questions	Question No.	Nature of questions	Weightage
I. Objective	1 – 4	Fill in the blanks	1
	5 – 8	Match the following	1
	9 – 12	Multiple choice	1
	13 – 16	True or False	1
II. Short Answer (Answer any eight)	17		1x8 = 8
	18		
	19		
	20		
	21		
	22		
	23		
	24		
	25		
	26		
	27		
	28		
Short Essay(Answer any 5)	29		2 x 5 = 10
	30		
	31		
	32		
	33		
	34		
	35		
	36		
IV. Long Essay (Answer any 2)	37		4 x 2 = 8
	38		
	39		
Total			30

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

Sem	*Hrs\ Wk* *Theory*	*Practical*	*No. Of Credits*	*Course*	*Title of Course*	*Instructional Hrs*
1	5	0	4			72
2	5	0	4			72
3	5	0	4			72
4	5	0	4			72

Table VII. Consolidation of Grade of a course

Exam	Grade	Grade points (G)	Weight (W)	Weighted grade points (WxG)
CE			1	
ESE			3	
Total			4	
Grade of Course	Total weighted grade points / Total weightage =			

GENERAL ASPECTS OF EVALUATION

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

Evaluation of each course shall involve Continuous Evaluation (CE) with a weight of 25 % and End Semester evaluation (ESE) with a weight of 75 % . A system of performance based direct grading will be used with Grades A-E and the Grade Points as shown below.

Performance	**Grade**	**Grade Point**	**Grade Range**
Excellent	A	4	3.50-4.00
Very Good	B	3	2.50-3.49
Good	C	2	1.50-2.49
Average	D	1	0.50-1.49
Below Average	E	0	0.00-0.49

I. 1. CONTINUOUS EVALUATION FOR LECTURE COURSES

The Continuous evaluation will have 25% percentage weight 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

Grades A-E will be awarded for each component. The weight is shown in Table I.1. There will be two dass tests for which, the average of the two grades obtained will form part of CE. Seminar for each course is to be organized by the course teacher and assessed 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. Total weight is 4.

I. 1. Components of CE For Lecture Courses			
No	*Component*	*Weight*	*Grades*
1	Attendance	1	≥90% - A <90 - ≥85% - B <85 - ≥80% - C <80 - ≥75% - D <75% - E
2	Assignment / Seminar	1	A-E
3	Test paper	2	A-E

I. 1. 1. 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. Both the assignment and the seminar will first be evaluated by awarding grades A-E based for each of the four components below in Table I.1.1. The seminar is to be conducted within the contact hour allotted for the course.

I. 1. 1. Mode of Assignments / Seminar Evaluation		
No	*Main Component*	*Grades*
1	Adherence to overall structure & submission deadline	All four main components present & satisfactory : A Only three : B Only two : C Only one : D None : E
2	Content & grasp of the topic	
3	Lucidity / Clarity of presentation	
4	References / Interaction/Overall effort	

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

I. 1. 1. 1. Guidelines for Assignments / Seminar Evaluation

No	*Main Component*	*Sub-Components*
1	Adherence to overall structure & submission deadline	i. Punctual submission ii. Adequate length/duration iii. Inclusion of Introduction, Discussion & Summary sections iv. Absence of errors/mistakes
2	Content & grasp of the topic	i. Coverage of topic ii. Understanding of topic iii. Logical organization iv. Originality (No copying from a source or plagiarism)
3	Lucidity / Clarity	i. Clarity ii. Effective presentation/delivery iii. Neatness of presentation iv. Inclusion of appropriate diagrams /equations /structures etc
4	References / Interaction/Overall effort	i. Listing of references ii. Use of more than one reference source/Use of Web resource iii. Correct Response to quiz /questions iv. Overall effort in preparing assignment/seminar

I. 1. 2. DETAILS OF THE CLASS TEST

1. The test has a duration of 1 hour.
2. Each question paper has four parts: A, B, C and D and the weight are shown in Table I.1.2.
3. Part A contains two questions. Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word- answer question (Objective).
4. Part B contains four questions. Out of these, the students have to answer two questions. Each answer should contain four points. Each question has a weight = 1(Short Answer).
5. Part C contains two questions of which the candidate has to answer one. Each question has a weight = 2. The answer must contain 8 points (Short Essay).
6. Part D contains two questions of which the candidate has to answer one. Each question has a weight = 4. Each answer must contain 16 points (Long Essay).

7. Total weight for the entire questions to be answered is 10.

I. 1. 2. Question Paper Pattern for Test		
Question No	*Type of Question*	*Weightage*
Part A: I.1-4; II. 4-8	2; Objective	1
Part B: 9-12	2 out of 4; Short Answer	1
Part C: 13,14	1 out of 2; Short Essay	2
Part D: 15,16	1 out of 2; Long Essay	4 Total = 10

I. 2. CONTINUOUS EVALUATION FOR LABORATORY COURSES

The Continuous evaluation will have 25% percentage weight. For 5th semester, only CE evaluation will be done; the corresponding ESE will be in 6th semesters. Grades A-E will be awarded for each component. There will be two quizzes / tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below in Table I. 2. Total Weight is 4.

I. 2. Components of CE For Lab Courses			
No	*Component*	*Weightage*	*Grades*
1	Attendance	1	≥90% - A <90 - ≥85% - B <85 - ≥80% - C <80 - ≥75% - D <75% - E
2	Experiment (Lab) Report	1	A-E [See Table I. 2. 1. Below]
3	Laboratory Skill	1	A-E [See Table I. 2. 2. Below]
4	Quiz / Test	1	A-E [See I. 2.3. below]

The guidelines for evaluating the two main components 2-4 using sub-component are presented below.

I. 2. 1. EVALUATION OF THE EXPERIMENT (LAB) REPORT

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, tables of data collected, equations, calculations, graphs, 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.

I. 2. 1. Mode of EXPERIMENT (LAB) Report Evaluation		
No	*Sub Component*	*Grades*
1	Punctual submission and Neat presentation	All four sub-components present & satisfactory : A Only three : B Only two : C Only one : D None : E
2	Inclusion of aim, materials, procedure etc.	
3	Calculations and absence of errors/mistakes	
4	Accuracy of the result	

I. 2. 2. EVALUATION OF THE LAB SKILL

Mode of Lab Skill Evaluation		
No	*Sub Component*	*Grades*
1	Punctuality and experiment completion on time	All four sub-components : A Only three : B Only two : C Only one : D None : E
2	Lab skill & Neat arrangements of table and apparatus in lab	
3	Prompt and neat recording of observations in lab note book.	
4	Experimental Skill and attention to safety	

I. 2. 3. EVALUATION OF THE LAB QUIZ / TEST

The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded

and the better grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

II. 1. END SEMESTER EVALUATION FOR LECTURE COURSES

The end semester evaluation will be done by the University at the end of the semester and it will have a 75% percentage weightage. End of semester University theory examination will be of 3-hr duration. Grades A-E will be awarded as per Regulations and the general aspects of evaluation

II. 1. 1. END SEMESTER QUESTION PAPER PATTERN

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 four questions . Each question contains four sub questions. Each question has a weight = 1. The questions may be in the forms - multiple choices, match the following, name the following or fill in the blanks or any one word- answer question (Objective type).
4. Part B contains twelve questions. Out of these twelve questions, the students have to answer eight questions. Each answer should contain four points. Each question has a weight = 1 (Short Answer type).
5. Part C contains eight questions of which the candidate has to answer five. Each question has a weight = 2. The answer must contain 8 points (Short Essay type).
6. Part D contains three questions of which the candidate has to answer two. Each question has a weight = 4. Each answer must contain 16 points (Long Essay type).
7. The total weightage for the entire questions to be answered is 30.

II. 2. END SEMESTER EVALUATION FOR LABORATORY COURSES

The components to be assessed as part of ESE of Lab courses and their weightage are discussed along with the syllabi for each of such laboratory courses in the subsequent sections.

III. EVALUATION OF THE PROJECT AND FACTORY VISIT

There shall be no continuous assessment for dissertation /project work and factory visit. At the end of Semester VI, a project report in duplicate and the factory visit report shall be submitted prior to the completion of the sixth semester. These reports will be

evaluated by a board of two Examiners appointed by the University. A project presentation and viva-voce based on the Project/Dissertation work shall be conducted individually. Grades A-E will be awarded as given below.

III. Evaluation of the project				
No	*Main Component*	*Weightage*	*Sub-Components*	*Grades*
1	Dissertation	15	i. Background/review & Objectives ii. Materials Methods iii. Results & Discussion iv. Summary/Conclusion & References	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
2	Project Presentation	6	i. Clarity & Understanding ii. Effective presentation & delivery iii. Content & Neatness of presentation iv. Time management & interaction	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
3	Viva voce	6	i. Understanding of project objective ii. Familiarization with Methods/Procedures iii.Background knowledge of Project & Subject iv. Correct and clear answers	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
4	Visit Report on Res. Institution /Factory	3	i. Brief Description of the Institute/Factory ii. Details of Instruments/Manufacture facility iii.Figures, Flowcharts, Pictures & Diagrams iv. Neat presentation & Summary	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E

IV. GENERAL ASPECTS OF COURSE AND CREDIT TRANSFER

As per Regulations, students from other institutions may be admitted in the 3rd and 5th by transfer subject to conditions prescribed by the University. Such transfers to a B. Sc. Chemistry Programme can be permitted only from a similar semester based three year degree programme with Chemistry as the major and maths as a compulsory complementary course and physics as a desirable complementary course. The requirements of the language, foundation and elective courses will be decided as per views of the concerned Board of Studies.

For core course transfers, the transferable credit per course is limited to 4 (as this is at present the highest credit per course in Univ. of Kerala) even if the source Institution awards a credit >4. If, however, a core course with comparable content, contact hours and mode of evaluation has a credit <4 at the source Institution, then the transferee may be awarded a credit in par with the similar course at this University.

SEMESTER I

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

COURSE CODE IC 1141–INORGANIC CHEMISTRY-I

Core Course-1 Credit-4 Total 54 hrs Lecture -3 hrs per week

Aim of the Course The course builds on the plus-two level introductory chemistry and familiarizes the students with the theoretical aspects of atomic structure. Subsequently, it delves into the chemistry of elements and their compounds . It also introduces the principles of chemical analysis and qualitative inorganic analysis at the laboratory.

COURSE OFFERING AND CREDITS

Semester I; credits: Four

COURSE OBJECTIVES

1. To understand the structure of atomic nucleus, properties of elements in relation to electronic configuration .

2. To learn the principles of chemical analysis. Upon course completion, the student will be able to appreciate how the inner structure of elements dictates the chemical properties of elements, how elements bond together to form compounds. S/He will acquire basic laboratory skills required for chemical analysis and become familiar with data collection, record keeping and data analysis in a chemical laboratory.

COURSE TRANSACTION FORMAT

Lecture-3- hours per week; eighteen 5-day weeks per semester.

Contact hours per semester: 54 hrs lecture

MODE OF EVALUATION

PART A.

Continuous Evaluation: 25% weight, continuous during semester. CE components are (i) Attendance for lecture and laboratory components, separately; (ii) class test for lecture part and (iii) assignment / seminar for lecture part, for which grades A-E will be awarded as per Regulations for each component. There will be two class tests (for which, the better of the two grades obtained will form part of CE) and one assignment / seminar during the semester lecture part.

End Semester Evaluation: 75% weight. End of semester University theory examination will be of 3-hr duration. Grades A-E will be awarded as per Regulations [See Regulations].

PART B.

Continuous Evaluation: CE component for Semester I is (i) Attendance.

End Semester Evaluation: End semester laboratory examination will be at the end of 4th semester. Grades will be awarded as per Regulations. [See Regulations].

COURSE SYNOPSIS

Introduction to atomic structure; electronic configuration and periodic properties; principles of chemical analysis and non-aqueous solvents.

To give the students an idea about atom, periodic properties of elements, chemical bonding and theory of bonding . To give an idea about the analytical principles.

Course outline

Module I - Atomic Structure ***9 hrs.***

Introduction- Wave mechanical concept of the atom - Dual Character of electron-de Broglie equation - matter waves and electromagnetic waves - experimental verification of de Broglie relation - Heisenberg's uncertainty principle - expression and physical significance. Schrodingers wave equation - Charge cloud and probability concepts - orbitals, radial and angular probability distribution curves, shapes of orbitals. Particle in a one- dimensional box. eigen functions and eigen values. Particle in a three dimensional box

Module *II* - *Electronic Configuration and Periodicity* ***9 hrs.***

Quantum numbers - Pauli's exclusion Principle - Aufbau Principle – Hund's rule - Electronic configuration of atoms - classification of elements into s, p, d, f blocks - atomic radii, ionization enthalpy, electron gain enthalpy and electronegativity- Pauling's scale, Mullikan and Alred - Rochow scale- ionic character - periodicity - horizontal, vertical and diagonal relationships - anomalous behaviour of the first element of a group.

Module III - *Analytical Principles - I* **9 *hrs.***

Qualitative Analysis - Common ion effect - solubility product - principle and procedure of elimination of interfering anions - precipitation of cations.

Quantitative Analysis - Calibration and use of apparatus and weights for titration.

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

Module IV ***-*** *Analytical Principles - II* ***9 hrs.***

Gravimetric Analysis - Mechanism of precipitate formation - Factors affecting solubility of precipitates - coprecipitation and post precipitation - Effect of digestion - washing, drying and ignition of precipitates. Chromatography - classification of methods - Elementary study of adsorption, paper, thin layer, ion exchange and gas chromatographic methods.

Module V Chemical Bonding –I **9 hrs**

Ionic bond-ionic solids and their structures, Rock salt, Rutile, Zinc blend, Wurtzite, radius ratio effect and coordination number, limitations of Radius ratio rule-lattice energy of ionic compounds- Born-Lande equation, Born-Haber cycle, solvation energy and solubility of ionic solids- covalent character of ionic bond, Fajan's rules

Covalent bond-valence bond theory and its limitations- hybridization, VSEPR theory and its applications- structure of XeF_2, XeF_4, XeF_6, ClF_3, IF_5, IF_7, NH_3,H_3O^+ & H_2O

Module VI : Chemical Bonding –II **9** hrs

VB theory of H_2 molecule, MO theory, LCAO of H_2^+ion, homonuclear diatomic molecules-C_2, B_2, N_2, O_2 and ions like O_2^+- heteronuclear diatomic molecules (HF, NO, and CO) –comparison of VB and MO theories

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

References

1) Manas Chanda, "Atomic structure and Chemical Bond including Molecular spectroscopy"

2) E.S. Gilreath "Fundamental concepts of Inorganic Chemistry"

3) Puri, Sharma and Kalia "Inorganic Chemistry"

4) Madan "Inorganic Chemistry".

5) Manku , "Theoretical principles of Inorganic Chemistry" -

6) M. C. Dey and J. Selbin "Theoretical Inorganic Chemistry".

7) F A Cotton and G. Wilkinson "Basic Inroganic Chemistry".

8) A. I. Vogel, "Text book of Qualitative Analysis"

9) A. I. Vogel, "Text book of Quantitative Inorganic Analysis".

10) A. K. Srivasthava and P. C. Jain, "Chemical Analysis".

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

SEMESTER I EXAMINATION

Time: Three Hours **IC1141- Inorganic Chemistry - I** **Weight 30**

Section A, Weight 1 each

Answer all questions in one word/sentence

I. Fill in the blanks

1. Splitting of spectral lines in a magnetic field is called ……
2. According to the uncertainty principle the accurate and simultaneous determination of the velocity and ---------- of a microscopic particle is impossible
3. Titrations involving acidified $K_2Cr_2O_7$ are examples for---------titrations.
4. Murexide is a----------indicator

II. Answer in one word

5. Quantum number which determines the orbital angular momentum of the electron
6. One half of the distance between the nuclei of the two covalently bonded atoms of the same element in a molecule.
7. What is the hybridisation in XeF_4 molecule
8. What is the shape of IF_7 molecule.

III. Fill in the blanks using appropriate words

9. Dissociation of acetic acid is suppressed on adding sodium acetate.. This is an example for----------
10. A substance is precipitated when its---------- exceeds the solubility product.
11. In the precipitation of Nickel, DMG is the ----------
12. The process of allowing the precipitate to stand for several hours in contact with the solution from which it was formed is called----------

IV. Answer in one word

13. The unit of dipole moment.
14. Bond order in carbon monoxide.
15. Geometry of NH_3.
16. What is zinc blend? **1×4 = 4**

Section B, Weight – 1 each (Short answer type)

Answer any 8 from the following. The Answer must contain 4 points.

17. Draw all the d orbitals.
18. Write the Schrodinger wave equation. Explain the terms.
19. State and illustrate Pauli's Exclusion Principle
20. Arrange F, Cl, Br and I in the increasing order of their electron gain enthalpy values. Give appropriate reason.
21. What is common ion effect. Give an example.
22. What are the different types of titrations.
23. Describe the effect of temperature on precipitation.
24. What is meant by R_f value? What is its use in chromatography?
25. Which is more covalent in character, AgBr or AgI. Explain .
26. How is percentage ionic character calculated?

27. What is VSEPR theory?
28. Distinguish between titrant and titrate. **1×8 = 8**

Section C, Weight – 2 each (Short essay type)

Answer any 5 from the following. The answer must contain 8 points.

29. Explain the diagonal relationship of elements with example
30. Explain uncertainty principle clearly bringing out its physical significance.
31. Write a note on (a)metallochromic indicators. (b) elimination of phosphate anion during the analysis of cations
32. Describe briefly co-precipitation and post- precipitation.
33. Which is more stable, O_2 or O_2^+.Explain
34. Write a note on Born- Haber cycle.
35. Obtain the solution of Schrodinger wave equation of a particle in a one – dimensional box.
36. Discuss the applications of common ion effect and solubility product in quantitative analysis. **2×5 =10**

Section D, Weight 4 each (Long essay type)

Answer any two

37. Discuss the principles involved in various chromatographic separations.
38. Using VB theory explain the structures of XeF_2, XeF_4, XeF_6 and IF_5.
39. Explain the electronegativity in terms of Pauling, Mulliken and Alred – Rochow scales. **4×2=8**

SEMESTER I

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

IC 1121 - METHODOLOGY AND INFORMATICS

Foundation Course 1 **Credit 3**

Lecture-Tutorial-Lab: 2-0-1 hours per week; eighteen 5-day weeks per semester.

Contact hours per semester: 36 hrs lecture and 18 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. How to study Chemistry using the basics of informatics.

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 be able to apply Scientific methods independently.

COURSE CONTENT

PART A. LECTURES

Module – 1 : Methods and Tools of Science $ Experimentation in Science 9 Hrs

Laws of science – Basis for scientific laws and factual truths – revolutions in science – science and technology - hypothesis – observations and proofs. Revision of scientific theories and laws. Importance of models, simulations and virtual testing

Design of an experiment – experimentation - observation – data collection – interpretation and deduction – necessity of units and dimensions – repeatability and replication. Documentation of experiments – record keeping – connection between measurements and underlying theory. Types of experiments –. Choice and selection of instruments. Types of instrumentation. Accuracy and precision.

Module II – Data Handling in Science 9 Hrs

Documentation of experiments – Nature and types of data – typical example. Data interpretation significance of statistical tools in data interpretation errors and inaccuracies. Data presentation – graphics, tables, histograms and pi diagrams. Ethics in science – Scientific information – Depositories of Scientific information – primary, secondary and digital sources.

Module III- Science, Society and Various approaches of Science 9Hrs

Better understanding of Science-Science and culture, citizenship, social cohesion, work, employment, development and research- Multicultural society and Science strategies to meet challenges in twenty first century, Globalisation- Population

Knowledge transfer process- Knowledge dissemination and utilization- Process and product of Science- Acquisition of various basic process skills of Science- Problem solving method – enquiry Vs discovery approach- Development of Scientific creativity - induction-deduction methods –Integration of various methods.

Module IV – Overview of Information Technology 9 Hrs

Features of the modern personal computer and peripherals – computer network and internet – Introduction to mobile phone technology – purchase of technology – license – guarantee – warrantee - overview of operating system and major application of software. Data information and knowledge – knowledge management – internet as a knowledge repository – academic search techniques – creating your cyber presence – open access initiation – open active publishing models – Basic concepts of IPR, copy right and patents – plagiarism – Introduction to use of IT in teaching and learning – case study of educational softwares – INFLIBNET, NICNET, BRNET – academic services.

Module V – IT @ Service of Society 9 Hrs

IT and society –Cyber ethics, Cyber crime, Security, Privacy issues- overview of IT applications in medicine, Health care, Business, Commerce, Industry, Defense, law, Crime detection, Publishing, communication, resource management, weather forecasting, education, film and media, futuristic IT – Artificial intelligence, virtual reality. Typesettig with Latex, Introduction to Scilab\Matlab.

Module VI Introduction To Computer Applications in Chemistry and Cheminformatics 9 Hrs

Structure drawing, spread sheet and chemistry related soft wares, collection of chemistry soft wares by RISC, statistical analysis of experimental data using computers, mean mode deviation, standard deviation, plotting graph using spread sheet, preparation of seminar papers and project using computers.

Basics of cheminformatics, applications of cheminformatics, storage & retrieval, file format, visual screening, QSAR (Quantitative Structure Activity Relationship) Introduction to molecular modeling, computational chemistry and combinatorial chemistry.

References

1. T.F.Gieryn “Cultural boundaries of science”, Univ. Chicago Press 1999.

2. H.Collins and T.Pinch "The Golem : What everyone should know about Science." Cambridge Univ Press 1993.
3. Alexis Leon & Mathews Leon, "Computers Today", Leon Vikas
4. Dr 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
7. M Ravikumar "Information Technology for Higher Education".
8. Kolasani Sunil Kumar, K Ramakrishna and Digumarti Bhaskara Rao "Methods of Teaching Chemistry".
9. V. Rajaram, "Introduction to Information Technology ", Prentice Hall.
10. Newton R G "The Truth of Science ": New Delhi 2nd edition.

PART B. LABORATORY

COMPUTER LABORATORY

[No ESA for this component]

CompuLab based instruction on the use of IT in learning. Use of educational softwares, information mining from internet and using INFLIBNET/NICNET. Word processing and document preparation. Data handling and presentation. Introduction to Scilab\Matlab.

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

SEMESTER I EXAMINATION

Time: Three Hours **IC 1121 Methodology and Informatics** Weight 30

Section A, Weight 1 each (Answer in one word / sentence)

Answer all questions

I. 1. Test data are most validly used in
(a) Determining grades (b) Evaluating the effectiveness of instruction
(c) Diagonising pupil difficulty

(d) Orienting instruction and expectations at the level of the child

2. Which among the following is law?
   (a) F = ma (b) P a 1\V (c) dq = du + Pdv (d) V a T
3. Which among the following is the most fundamental characteristic of science?
   (a) formation of hypothesis (b) measurement
   (c) reproducibility of the measurement (d) experiment
4. Scientific creativity originate from
   (a) imagination (b) knowledge (c) various skills (d) experiments

II 5. A provisional supposition made in order to explain scientifically some fact or phenomenon is called ----------

6. ----------is not a process skill in Science.
7. The one which represents deduction is ----
8. The research development and diffusion model of Havlock is based on --------

III. 9. Guarantee is ------

10. The warrantee of goods purchased is--------
11. The first computer networking was established in the laboratories of -----
12. World Wide Web is --------

IV. State True or False

13. ARPANET is the predecessor of all computer networks.
14. All precise experimental results are accurate as well.
15. Scientific theories are invariant and not subject to questioning.
16. Chem Draw is an open source chemical structure drawing software.**1×4 =4**

Section B, Weight 1 each (short answer type)

Answer any 8 questions from the following(short answer type).

17. Give any four challenges of twenty first centuary related to science.
18. Distinguish between accuracy and precision with suitable examples.
19. Prepare a format for the documentation of the experiment to determine the hardness of a sample of water.
20. What are the basic components of the product of science?
21. What are the different CHEM study materials?
22. What are the features of modern personal computer?
23. Describe what is DOS and how it was later replaced?
24. Exemplify the use of a pi-diagram in presenting the results of a typical experiment
25. Comment on the role of INFLIBNET in science education and research in India.
26. What are the basics of chemoinformatics ?
27. Explain enquiry vs discovery approach.
28. What is visual screening ? **1×8 = 8**

Section C, Weight 2 each (short essay type)

Answer any 5 questions from the following. The answer must contain 8 points

29. What is meat by revision of scientific theories and laws ?
30. Explain documentation of experiments.
31. What are Depositories of Scientific Information ?
32. Explain the applications of software
33. Describe how you will gather information regarding the synthesis of polymer from internet .
34. What are the applications of IT in publishing and communication.

35. What is QSAR.
36. What is e-enabled learning . **2×5 = 10**

Section D, Weight 4 each (long essay type)

Answer any two questions

37. Distinguish between mathematical methods and scientific methods .
38. Explain primary, secondary and digital sources
39. Explain introduction to use of IT in teaching and learning. **4×2 = 8**

SEMESTER II

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

COURSE CODE IC 1241–INORGANIC CHEMISTRY-II

Core Course-3 **Credit-4** **Total 72 hours**

Lecture-: 4- hours per week

Aim of the course: Bonding among atoms, nano Chemistry and radioactivity are the main topics in this course. Nano field is the developing area in science.

Objective of the Course: It gives the students an idea about the theories of bonding, nuclear chemistry and nano materials.

Module- I Chemical Bonding III **12** hrs

Metallic bonding- free electron theory, VB theory and band theory(Qualitative treatment only)- weak electrical forces – hydrogen bond, inter and intramolecular hydrogen bond, intermolecular interaction – induction forces and dispersion forces such as van der Waals forces, ion –dipole, dipole-dipole, ion-induced dipole, dipole-induced dipole, induced dipole-induced dipole interactions.

Module II **12** hr

Concepts of Acids and BasesArrhenius theory, Lowry – Bronsted theory, Lewis theory. Hard and soft acids and bases, the SHAB principle, relative strength of acids and bases, effect of solvent on acid and base strengths**,** Evaluation of analytical data, Significant figures, types of errors. standard deviation, relative standard deviation, Student t test , F test, Q test.

Module III : Nuclear Chemistry **12**hrs

Natural radioactivity, modes of decay, Geiger–Nuttal rule, artificial transmutation and artificial radioactivity- nuclear stability, n\p ratio, mass defect and binding energy, nuclear fission and nuclear fusion, elementary idea of subatomic particles like neutrino, anti neutrino -applications of radioactivity- C^{14} dating, rock dating , neutron activation analysis and isotope as tracers

Module IV : Non Aqueous Solvents **12**hrs

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_2, liquid HF.

Module V: Instrumental Methods of Analysis **12hrs**

Atomic absorption spectroscopy- flame emission spectroscopy- applications - spectrophotometry- laws of spectrophotometry- applications of spectrophotometry- colorimetry, thermal methods- introduction to TG, DTA and DSC- instrumentations and applications.

Module VI : Chemistry of Nanomaterials **12hrs**

, volution of Nanoscience – Historical aspects- Preparations containing nano gold in traditional medicine. Lycurgus cup- Faraday's divided metal, 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 .

Carbon nanotubes and fullerenes.

Reference:

1. F. A. Cotton, G. Wilkinson and P. L. Gaus, "Basic Inorganic Chemistry" ; Willey
2. J. D. Lee, "Concise Inorganic Chemistry", ELBS
3. M. C. Day and Selbin,"Theoretical Inorganic Chemistry".
4. J. E. Huheey ,"Inorganic Chemistry- Principles and Structure and Reactivity".
5. H. S.Arniker,"Essentials of Nuclear Chemistry".
6. Sisler,"Non-aqueous Solvents".
7. E. S. Gilreath, " Fundamentals of Inorganic Chemistry" .
8. Willard, Merrit ,"Instrumental Methods of Analysis".
9. Shriver and Atkins,"Inorganic Chemistry" .
10. Bosolo and Johnson ,"Coordination Chemistry".
11. S. F. A. Kettle, "Coordination Chemistry".
12. J. E. Huheey,"Inorganic Chemistry".
13 . T. Pradeep, "Nano, The Essentials", Mc Graw- Hill Education.

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

SEMESTER II EXAMINATION

Time: Three Hours **IC 1241 Inorganic Chemistry II** ` Weight 30

Section A, Weight 1 each (Answer in one word\sentence)

Answer all questions

1. Example of a weak acid is _____.
2. Conjugate base of HF is _____.
3. The isotope for carbon dating is _____.
4. Hydrogen bonding in salicyl aldehyde is _____molecular.

II. 5. Name the interactions present in I_3^- .
6. Write n\p ratio of stable nuclei.
7. Name a naturally occurring radioactive element.
8. Name a radioactive element used in cancer treatment.

III. 9. Water is an example for---------- solvent.
10. Alkali metals in ammonia give a _____ colour.
11. An aprotic non-aqueous solvent is _____ .
12. Beer- Lambert's law is mathematically expressed as _____ .

IV. 13. Expansion for DSC is ----------.
14. Frequency of sound waves used in sonochemistry is _____.
15. C- 60 is known as----------.
16. Faraday prepared _____ sols as the divided metal. **1×4 = 4**

Section B. Weight I each (Short answer type)

Answer any eight questions from the following. The answer must contain 4 points.

17. Explain Lowry- Bronsted theory of acids and bases.
18. What is Student t test?.
19. What is SHAB principle?.
20. What is Geiger –Nuttal rule.
21. Explain with example artificial transmutation.
22. Define binding energy.
23. Write a note on protic and aprotic solvents.
24. Write a method for preparing Ag nano particle..
25. What is flame emission spectroscopy .
26. Ortho nitro phenol is more volatile than para nitro phenol. Why ?
27. Explain sol- gel synthesis.
28. The normality of a solution is determined by four separate titratons, the results being 0.2041, 0.2049, 0.2039 and0.2043. Calculate the standard deviation.

1×8 = 8

Section C, Weight 2 each (Short essay type)

Answer any five questions from the ollowing. The answer must contain 8 points.

29. Explain different theories of metallic bonding.
30. Distinguish between levelling solvents and differentiating solvents
31. Discuss the general characteristics of a solvent.
32. What is van der waal's force. Explain the different types of interactions.
33. How will you prepare a nano system using hydrothermal technique.
34. Give the principle and instrumentation of DTA.
35. Using TG data explain the decomposition of $CaC_2O_4.H_2O$.
36. A freshly cut piece of wood gives 16100 counts of ß-ray emission per minute per kg and an old wooden bowl gives 13200 counts per minute per kg. Calculate the age of the wooden bowl. The half-life period of carbon is 5568 years.

2×5 = 10

Section D, Weight 4 each (Long essay type)

Answer any two questions.

37. Using suitable examples illustrate how DTA is complementary to TG.
38. Write notes on 1. Nuclear Fission. 2. Nuclar Fusion. 3.mass defect
39 Write a note on liquid ammonia as a non-aqueous solvent. **4×2 = 8**

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – II

IC 1221- METHODOLOGY OF CHEMISTRY

Fondation Course 2 Credit 2 Lecture - 2 hrs per week Total 36 hrs

Aim: To familiarize the students with the methodology of science with special reference to chemistry

Objectives:

- To have a broad outline of the methodology of science in general and Chemistry in

particular

- To understand the important analytical and instrumental tools used for practicing chemistry
- To learn computer based presentation and statistical analysis of data using spreadsheet software
- To apply these skills in the analysis of experimental data in chemical analysis

Module – 1 : **Chemistry as a discipline of science** **9 hrs**

What is science? Scientific statements, Scientific methods–observation-posing a questionformulation of hypothesis-experiment-theory-law. Falsification (disproving) of hypothesis, inductive and deductive reasoning, revision of scientific theories and laws.
Methods of science as illustrated through the following
i) Laws of chemical combination- Faradays laws of electrolysis- Daltons atomic theory atom models- J.J.Thomson, Rutherford, Bohr model and quantum mechanical model of atom.
ii) n-P-V-T relation of gases-gas laws-kinetic molecular theory, Role of concepts and models in science. Evolution of Chemistry- ancient speculations on the nature of matter, early form of chemistry-alchemy, origin of modern chemistry.Structure of chemical science: scope of chemical science,theory and experiment, branches of chemistry. Role of Chemistry as a central science connecting Physics, Biology and other branches of science. Interdisciplinary areas involving Chemistry- Nanotechnology, Biotechnology.
Chemical science in the service of man: Drugs, food, flavouring agents, sweeteners, cosmetics, soaps and detergents, paints, varnishes, textiles, dyes, fertilizers, insecticides, fuels etc - examples in each. Methodology of chemistry: Symbols, formulae, Chemical equations, classification

Module 2. **Research in Science** **9 hours**

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

Module 3. **Analytical and synthetic methodologies in Chemistry** **9 hours**

Titrimetric analysis: fundamental concepts - mole, molarity, molality, ppm and ppb primary standard-secondary standard, quantitative dilution – problems. Acid base titrations- titration curves –pH indicators. Redox titrations – titration curve –titrations involving MnO_4^- and $Cr_2O_7^{2-}$
Redox indicators. Complexometric titrations – EDTA titrations - titration curves - indicators-

Gravimetric analysis: Unit operations in gravimetric analysis Illustrations using iron and barium estimation.

Synthetic methodologies – condensation – addition- examples.
Separation and purification techniques – Filtration, Crystallization and precipitation – concept of solubility product as applied in group separation of cations – problems. Fractional distillation, Solvent extraction.

Module 4. **Data Analysis** **9 hours**

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

confidence limits – tests of significance – Correlation and regression – linear regression analysis, calculation of regression coefficients (slope, Intercept) using scientific calculator - methods of least squares.

References

1. J.A Lee, Scientific Endeavor, Addison Wesley Longman
2. C. N. R. Rao, University Chemistry, Universities Press (India) Pvt Ltd
3. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi(Chapter40)
4. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson (Chapters 12-17)
5. Vogel's Textbook of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd
5. G. D. Christian, Analytical Chemistry, JohnWiley and Sons

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

SEMESTER II EXAMINATION

IC 1221- METHODOLOGY OF CHEMISTRY

Time: Three Hours

Weight 30

Section A, Weight I (Answer in one word/sentence)

Answer all questions

1. The chemical equation for the formation of ammonia is N_2+…… $2NH_3$.
2. The general formulae for alkenes is …….
3. The horizondal rows in the modern periodic table are known as …….
4. The ideal gas equation is …….

II.

5. Aspirin is a -------
6. Name of an artificial sweetener
7. Example of a redox indicator is
8. Fractional distillation is employed for separating --------

III.

9. The number of moles of solute present in one litre of solution is called ……
10. Name an indicator suitable for the titration of hydrochloric acid with sodium carbonate.
11. Among $K_2Cr_2O_7$ and $KMnO_4$, which can be used as a primary standard?
12. The product of the molar concentrations of the ions in a saturated solution of the sparingly soluble salt, each raised to the power equal to the stoichiometric coefficient of the species, in the balanced chemical equation is called ……

IV.

13. The number of significant figures in 120.00 is ……..
14. The numerical difference between a measured value and the absolute value of am analytical determination is called ……

15. A graph for the equation y = 5x + 8 is a ----------
16. The amount of Barium determined in a sample for five successive dterminations are 0.456, 0.458, 0.459. 0.453. The mean value is ……

Section B, Weight I (short answer type)
Answer any eight questions

17. State Faraday's first law of electrolysis.
18. What is a drug?
19. What is meant by quantitative analysis?
20. Define a variable.
21. How soap is different from detergent?
22. What are the indicators in cmplexometric titrations?
23. Calculate the amount of water that should be added to convert 100ml 1N solution of HCl to exactly decinormal.
24. What is meant by ppm?
25. Give an example for autocatalysis.
26. How will you determine the slope of line?
27. How standard deviation and variance related?
28. How will you round off the value 68.752 to three significant figures?

Section C, Weight 2 (short essay type)
Answer any five questions

29. Explain the Bohr atom model.
30. What is a dye? What are the essential characteristics for an effective dye?
31. Explain the relation between correlation and causality
32. Discuss the different types of experimental bias in scientific research.
33. The precipitation of group III cations as hydroxides should be done in the presence of excess NH4Cl, explain the reason.
34. Explain the principle of fractional distillation.
35. Differentiate between accuracy and precision.
36. What is F-test and t-test? For what purpose are these tests applied?

Section D, Weight 4 (Long essay type)
Answer any two questions

37. Derive the ideal gas equation PV = nRT.
38. Discuss the gravimetric estimation of barium as bariumsulphate.
39. What is meant by errors? Discuss the different types of errors and methods for minimizing these errors.

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – III

IC 1341 ORGANIC CHEMISTRY - I

Core Course – 5 Credit 3 Lecture - 3 hrs per week Total 54 hrs

Aim of the Course: The syllabus includes hybridization, mechanism of reactions, aromaticity and the chemistry of aliphatic and aromatic substituted compounds.

Objective of the Course : It learns the behaviour of aliphatic and aromatic compounds like aromatic aldehydes, ketones and halides. By studying this topics the students get an idea of the mechanism of reactions of organic compounds and hybridization.

Module I: Hybridisation and various types of reagents (**9 hours**)

Hybridisation – sp^3, sp^2 and sp, structure and shapes of simple organic molecules, bond lengths, bond angles and bond energy, Electron displacement effects – inductive effect, electromeric effect, hyperconjugation, resonance, steric effect. Homolytic and heterolytic fission.

Types of organic reactions, energy considerations. Reaction intermediates – carbocations, carbanions, free radicals, carbenes, benzynes. Methods of determination of reaction mechanism – product analysis, intermediates, isotope effect, kinetic and stereochemical studies.

Module II: Reaction mechanism **(9 hours**)

Mechanism of addition of hydrogen, electrophilic and free radical addition, Markownikoff's rule and kharasch effect. Mechanism of nucleophilic and electrophilic addition reactions, Nucleophilic and electrophilic substitution reactions, elimination reactions – E1, E2, S_N1, S_N2 and S_Ni reactions and mechanisms. Study of reactions of hydroboration, epoxidation, ozonolysis, hydration, cis-hydroxylation.

Module III: Arenes & Aromaticity **(9 hours**)

Nomenclature of benzene derivatives, Aromaticity, Huckel's rule, Non-benzenoid aromatic compounds – 5 membered and 7 membered ring compounds-structure of benzene.

Mechanism of aromatic electrophilic substitution in benzene– halogenation, nitration, sulphonation, Friedel-Crafts alkylation, acylation. Energy profile diagram. Orienting effect of substituents like –OH, $-NH_2$, $-NO_2$, $-CH_3$ and halogens. Nucleophilic aromatic substitution. Elimination-addition mechanism, reactivity and orientation-aromatic electrophilic substitution in naphthalene- Friedel- Crafts alkylation and nitration.

Module IV: Substituted Arenes, Alkyl halides & Aryl halides **(9 hours**)

Methods of formation of alkyl benzenes, alkynyl benzenes, and biphenyl. Preparation and properties of aryl halides.

Alkyl halides: Nomenclature and classes of alkyl halides, preparation and properties, Synthetic uses of vinyl chloride, chloroform, carbon tetrachloride, trichloroethylene, chloroprene, Freon-12, DDT, BHC.

Module V: Alcohols & Phenols **(9 hours**)

General methods of preparation and properties of alcohols. Methods to distinguish primary, secondary and tertiary alcohols. ascent and descent in alcohol series. Oxidation

of alcohols with acidified $KMnO_4$, $K_2Cr_2O_7$. Jones reagent and PCC (Pyridinium Chloro Chromate).

Polyhydric alcohols: - Preparation and properties of ethylene glycol and glycerol, their industrial importance.

Phenols: - Preparation and properties of phenols. Acidity of phenols and its comparison with alcohols and acids. Effect of substituents on acid strength of Phenols. Industrial Importance of methanol, ethanol – Absolute alcohol methylated spirit, power alcohol, allyl alcohol, benzyl alcohol, picric acid, quinol and nitro phenols.

Module VI: Aldehydes and Ketones (**9 hours**)

Aldehydes and Ketones: - General methods of preparation and properties of aldehydes and ketones (both aliphatic and aromatic). Reduction with $LiAlH_4$, Sodium borohydride, Aluminium Iso Propoxide Wolf-Kishner reduction, Clemmenson reduction. Test to distinguish aldehydes and ketones. Condensation reactions and its Mechanisms – Aldol condensation, mixed and crossed aldol condensation and benzoin condensation. Preparation and uses of crotonaldehyde, mesityl oxides, cinnamaldehyde, salicylaldehyde, vanillin, naphthaquinone and anthraquinone.

References

1. I L Finar, "Organic Chemistry - Vol. I", Longman
2. M K Jain, "Principles of Organic Chemistry",
3. Morrison & Boyd, "Organic Chemistry", Prentice Hall
4. Peter Sykes, "A Guide book to Mechanisms in Organic Chemistry", Longman
5. Jerry March, "Advanced Organic Chemistry", Wiley
6. Bahl & Bahl, "Advanced Organic Chemistry"
7. Tewari & Mahrotra, "A text book of Organic Chemistry"
8. P L Soni, "Organic Chemistry"
9. Rein hard Bruckner, "Advanced Organic Chemistry Reaction Mechanisms"
10. Arun Parikh, Hansa Parikh, Khyati Parikh, "Name Reactions in Organic Synthesis".

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

SEMESTER III EXAMINATION

IC 1341 ORGANIC CHEMISTRY – I

Time : Three Hours **Weight: 30**

Section-A, Weight 1 each

Answer all questions. Answer in one word\sentence.

I. 1. Write down the formula of chloroprine.
2. In Gattermann's reaction, which is used as the catalyst ?

3. In Victor Meyer's test blue colour is shown by _____ alcohol .
4. What is the general formula of Grignard reagent ?

II. 5. What happens when propene is subjected to ozonolysis ?
6. What is chemical name of Urotropin ?
7. Predict the product obtained on nitration of methyl benzene.
8. What is picric acid ?

III. 9. Which compound is easily nitrated, benzene or nitro benzene ?
10. What is the chemical formula of Freon - 12 ?
11. Write an example of annulene.
12. Write an example of non-benzenoid aromatic compound .

IV. 13. Complete the equation $RCOCl \xrightarrow[H2]{Pd\BaSO4} ----------$

14. Complete the equation $C_6H_6 + C_6H_5CH_2Cl \xrightarrow{AlCl3} ----------$

15. Identify X Glycerol + Oxalic acid $\xrightarrow{110?\ C}$ X

16. Phenol_ _ $\xrightarrow{CHCl3+KOH}$ _____ ? **1×4 = 4**

Section – B (Short answer type) Weight- 1 each

Answer any 8 questions from the following.The answer must contain 4 points

17. Indicate the type of hybridization of carbon atom in the following compounds.
(a) CH_3Br (b) CH_3OH (c) HCN (d) HCHO
18. Phenol is acidic while ethanol is not. Why ?
19. Arrange the following in the increasing order of stability.
$(CH_3)_2\overset{+}{C}H$, $CH_3\overset{+}{}$, $(C_6H_5)_2\overset{+}{C}H$, $C_6H_5\text{-}\overset{+}{C}H_2$
20. Give an example and state Hofmann's rule.
21. What is Kharasch effect ? Illustrate with an example.
22. When toluene is nitrated the major products are ortho and para substituted products. Why ?
23. Write briefly the mechanism of nitration of benzene.
24. Define Huckel's rule.
25 Predict the products obtained on the nitration of
(1) 1,2-dibromo benzene (2) 1,3-dibromo benzene
26. Distinguish between aldehydes and ketones.
27. How will you convert ethylene to ethylene glycol ?
28. Write a note on aldol condensation. **1×8 = 8**

Section C (Short essay type) Weight-2

Answer any 5 questions from the following. The answer must contain 8 points.

29. Give an account of the stability of carbocations.
30. Halogens are electron withdrawing yet they direct the incoming electrophile to ortho-para positions. Why ?
31. Compare SN^1 reaction rates and SN^2 reaction rates of methyl, ethyl, iso-propyl and t-butyl halides.

32. Write briefly on the mechanism and orientation of aromatic nucleophilic substitution reactions proceeding through benzyne intermediates.
33. Give a detailed account of the role of group already present in the aryl ring in directing the incoming group in an electrophilic substitution reaction.
34. Discuss the molecular orbital structure of Benzene.
35. Discuss the mechanism of addition polymerization initiated by free radicals.
36. Write a note on aromatic electrophilic substitution. **2×5 = 10**

Section –D (Long essay type)

Answer two questions. Weight-4

37. (a) How is vanillin prepared ? What are its uses?
    (b) Write a note on absolute alcohol and power alcohol.
    (c) What are the products formed on nitration of the following compounds.
    Phenol, chlorobenzene, nitrobenzene and benzoic acid.
    (d) Write a note on Wolf- Kishner reduction and Clemmenson reduction.
38. Give a detailed account of the generation, structure and stability of free radicals, carbanions and singlet and triplet carbenes.
39. Explain the mechanism of E_1 and E_2 eliminations. **4×2 = 8**

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – III

IC 1342 PHYSICAL CHEMISTRY – I

Core course – 6 Credit – 3 Total: 72 hours Lecture - 4 hours per week

Aim of the Course: The syllabus deals with the different states of matter, thermodynamics and group theory. It attempts to familiarize the student with the defects in crystals and point groups of simple molecules.

Objective of the Course: To make the students aware of the different states of matter, liquid crystals, basics of group theory and thermodynamic properties like entropy, enthalpy and free energy .

Module I – Gaseous state (12 hours)

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, Collision frequency, Collision number, Collision diameter and mean free path.

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 most probable velocity, Derivation of root mean square, most probable and average velocities from the equation.

Critical phenomena: Isotherms of CO_2, continuity of states, Critical constants and their experimental determination, relation between critical constants and van der Waals constants.

Module II – Solid state (12 hours)

Isotropy and anisotropy, Space lattice and unit cell, Elements of symmetry of crystals, Bravais lattices, Crystal systems, Laws of crystallography, 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 Imperfections in crystals, point defects – Schottky and Frenkel defects, Non-stoichiometric defects.

Module III – Liquid state and Dilute solutions (12 hours)

Properties of liquids: Surface tension and its measurement by capillary rise and stalagmometer method, factors affecting Surface tension, Viscosity, Poisuelle'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, relative lowering of vapour pressure Thermodynamic derivation of $?T_b = K_b \times m$ and $?T_f = K_f \times m$, Osmotic pressure, van't Hoff equation and molecular mass, Isotonic solutions, 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 (12 hours)

Basic concepts- system, surroundings, types of systems. Extensive and intensive properties, macroscopic properties. State functions and path functions. Types of Processes, Zeroth law of thermodynamics

Definition of internal energy and enthalpy. Heat capacities at constant volume (Cv) and at constant pressure (Cp), relationship between Cp and Cv. 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.

Module V – Thermodynamics II (12 hours)

Need for II^{nd} law. Different statements of II^{nd} law, Thermodynamic scale of temperature. Carnot cycle and its efficiency, Carnot theorem.

Concept of entropy- Definition and physical significance. Entropy as a function of volume and temperature, Entropy as a function of pressure and temperature. Entropy as a criteria of spontaneity and equilibrium.

Gibbs and Helmholtz free energies and their significances- criteria of equilibrium and spontaneity. Gibbs-Helmholtz equation, dependence of Gibbs free energy change on temperature, volume and pressure. Maxwell's relations

Partial molar quantities- Chemical potential-Gibbs-Duhem equation. Concept of fugacity, determination of fugacity by graphical method.

Module VI – Group theory & Liquid crystals (12 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, Point groups, C_{2V}, C_{3V} and D_{3h}, Group multiplication table of C_{2V}, Determination of point groups of simple molecules like H_2O, NH_3 and BF_3.

Liquid crystals: Types of liquid crystals – smectic, nematic and cholesteric, Swarm theory of liquid crystals, uses of liquid crystals.

(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

6. Puri, Sharma and Pathania, "Principles of Physical Chemistry", Millennium Edition, Vishal Publishing Co

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.

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

SEMESTER III EXAMINATION

IC 1342 PHYSICAL CHEMISTRY – I

Time : Three Hours **Weight: 30**

Section A. Weight- 1 each (answer in a word\sentence)

Answer all questions

I. 1. The average speed of a certain gas at 27^oC is $400ms^{-1}$. The temperature at which the speed will be $800ms^{-1}$ is----------

2. NH_3 belongs to_____ point group.

3. The temperature at which the second virial coefficient of a real gas is zero is called----------

4. The van der waal's equation for n moles of a gas is----------

II. 5. Total number of Bravais lattices in a crystal is ----------

6. NaCl has F.C.C. structure. The number of Na^+ and Cl^- ions in the unit cell is ----

7. Efficiency of Carnot engine working between temperatures T_1 and T_2 is…… .
8. The total number of space groups in a crystal is ---------

III. 9. The unit of surface tension of a liquid is ----------

10. Give an example of a liquid crystalline substance.
11. Isotonic solutions must have the same -----
12. The Van't Hoff equation for osmotic pressure of a dilute solution is --------

IV 13. Work done in a reversible process is ----------

14. Gibb's free energy relation is ----------
15. The temperature at which the Joule- Thomson coefficient changes sign is known as ----------
16. For a cyclic process ?E =

Section B. Weight-1 each (short answer type)

Answer any 8 from the following. The answer must contain 4 points.

17. What is the law of rationality of indices?
18. What is Poisuellie`s equation?
19. Explain van't Hoff factor
20. Explain first law of thermodynamics.
21. Derive the expression for Joule Thomson coefficient
22. Explain any two statements of second law of thermodynamics.
23. Explain the physical significance of entropy
24. What are the proper and improper axes of symmetry
25. Draw the group multiplication table of C_{2v} point group
26. Define the terms collision frequency and collision number.
27. Explain virial equation of state.
28. Explain elements of symmetry of crystals. **1×8 = 8**

Section C. Weight 2 each (short essay type)

(Answer any 5 from the following). The answer must contain 8 points.

29. Derive root mean square velocity and average velocity from Maxwell-Boltzmann equation.
30. 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^{-1} mol^{-1}
31. What are Rast`s method and cooling curve method of determining molar mass?
32. Explain Hess's law and its applications
33. Explain Gibbs - Helmholtz equation and its significance
34. Explain Swarm theory of liquid crystals. Mention two applications of liquid crystals.
35. What is chemical potential and derive Gibbs Duhem equation.
36. How will you experimentally determine the critical constants of a gas.**2×5 = 10**

Section D. Weight-4 each (long essay type)

(Answer any two from the following)

37. Explain Linde's and Claude's method of liquefaction of gases.
38. Derive Bragg's equation. The density of LiF is 2.601 g cm^{-3} . The (111) first order reflection in the X-ray diffraction from LiF occurs at 8 ? 44 ?, when X-

rays of wavelength 70.8pm are used. If there are four LiF molecules per unit cell, calculate Avogadro number.

39. What is Kirchoff`s equation? The enthalpy of reaction for the formation of ammonia according to reaction $N_2 + 3H_2$? $2NH_3$ at 25 ?C was found to be -91.94Kj mol^{-1}. What will be the enthalpy of reaction at 50? C ? The molar heat capacities at constant pressure and at 27?C for Nitrogen, Hydrogen, Ammonia are28.45, 28.32 and 37.07 Joules mol^{-1}respectively.\ **4×2 = 8**

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – III

IC 1371 INDUSTRIAL CHEMISTRY- I

Vocational Course – 1 Credit 4 Lecture-4 hrs per week Total 72 hrs

Module 1. Industrial Aspects of Inorganic Chemistry 12 hrs

Concentration of ores – gravity separation, magnetic separation and froth Floatation processes with suitable examples.

Metallurgical process + Pyrometallurgy – Sintering, calcination and roasting Smelting (principle with one example).

Hydrometallurgy – Leaching and reduction from solution with one example (Principle and chemical equations only).

Electrometallurgy – molten salt electrolysis and aqueous solution electrolysis with One example (principle and chemical equations only).

Reducing agents in metallurgy – C, CO, hydrogen, metals with at least one Example.

Van Arkel method, Zone refining

Principles of extraction of Iron, Copper, Lead, Silver, Sodium, Aluminium, Magnesium, Zinc , Chromium.

Module 2 Industrially important inorganic materials 12 hrs

Cement – Manufacture, composition and setting.

Glass – Manufacture – annealing – types of glasses – uses.

Ceramics – Definition, traditional and new ceramics – structure of ceramics – uses – Inorganic fertilizers – essential nutrients for plants – nitrogenous, phosphatic and potash fertilizers.. Refractory materials – carbides and borides

Module 3 Industrial aspects of Organic Chemistry 12 hrs

Raw materials for organic compounds-Petroleum, natural gas, fractionation of crude oil, cracking, reforming, hydroforming, isomerisation

Coal Types, structure, properties , distillation of Coal and chemicals derived from them

Module 4 Chemical Industries in Kerala 12 hrs

Chemical Industries in Kerala – Sugar, alcohol, TiO_2, glass, cement, HCl, H_2SO_4, NaOH, Urea, Ammonium phosphates and Super phosphate of lime (Location, raw materials, Chemistry involved in the preparation and uses)

Module 5 Basics of Polymer Industry 12 hrs

Polymers – Homo polymers, copolymers, branched and crosslinked polymers, graft and block copolymers, rubbers, plastics, thermoplastics, thermosetting plastics, fibres (characteristic features of each). Natural and synthetic polymers – basic concept of monomers, functionality, molecular weight of polymers

Module 6 Separation and Purification Techniques 12 hrs

General principles involved in the separation of precipitates, standards of purity, mixed melting point and boiling point; purification of solid organic compounds – extraction, use of immiscible solvents, solvent extraction, crystallization, fractional crystallization,

I. sublimation, desiccants, vacuum drying. Purification of liquids – distillation, vacuum distillation, fractional distillation, steam distillation, azeotropic distillation – principles and techniques.

References

1 S.K.Agarwala and Keemitilal Advanced Inorganic Chemistry

2. Puri, Sharma and Kalia . Principles of Inorganic Chemistry

II. 3, P.L. Soni, . Text book of Inorganic Chemistry

4. W.D.Eingery, H.K.Dowen and R.D.Uhlman 'Introduction to Ceramics'

5 K.R.Rajan Industries in Kerala

6. Emelns and Anderson Principles of Inorganic Chemistry

III. 7, Tewari & Mahrotra, "A text book of Organic Chemistry"

8. P L Soni, "Organic Chemistry"

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

IV.

SEMESTER III EXAMINATION

Time : Three Hours **Weight: 30**

IC 1371 INDUSTRIAL CHEMISTRY- I

Section A
Weight 1 (answer in a word/sentence)
(Answer all questions)

1. Among the ores, Aluminium oxide and Lead sulphide, which is concentrated using froth floatation process?
2. Give the name of a metal which is extracted by smelting process.
3. Which compound is produced by the Contact process?
4. In hydrometallurgy, which term is used to refer the process of making the ore into a solution of the metal?
5. Give an example of a metal which is purified by Van Arkel method.
6. Give an example of a metal which is purified by Zone refining.
7. Which refining technique is used to prepare extra pure silicon?
8. Which process is used for the extraction of chromium?
9. Which compound is added to cement for achieving its desired setting qualities?
10. Glass does not have a definite melting point but softens gradually over a range of temperatures. State whether this statement is TRUE or FALSE.
11. Give an example for a nitrogenous inorganic fertilizer.
12. Give an example for a neutral refractory material

13. Among anthracite, bituminous and lignite, which coal is having the highest carbon content?
14. Name the monomer of natural rubber.
15. Among polyethylene and bakelite, which is a thermosetting plastic?
16. Which purification method is suitable for the preparation of pure iodine from impure Iodine?

Part B (Short answer type)
(Answer any 8 questions, weight 1)

17. What do you mean by concentration of ore?
18. Explain the difference between roasting and calcinations.
19. Explain smelting with a suitable example.
20. What are the essential nutrients for plants that have to be supplied by fertilizers? Give one example of fertilizer for each nutrient.
21. What are refractory materials? Give an example for a carbide refractory material.
22. What is meant by hydroforming in petroleum refining?
23. What is meant by cracking in petroleum refining?
24. Comment on the cement industries in kerala.
25. In Kerala, which are the factories manufacture urea? Explain briefly the steps in its preparation.
26. Explain homopolymer with a suitable example.
27. Explain the benefits of vacuum distillation using an example.
28. What is meant by sublimation? Give one example where sublimation is used as a purification technique.

Part C (Short Essay type)
(Answer any 5 questions. Weight 2)

29. Explain hydrometallurgy using a suitable example.
30. What do you mean by ceramics? Give examples for traditional and new ceramics.
31. What are the raw material
32. What are the different types of coal? How are these differ in their activity as a fuel?
33. Explain the synthesis of sulphuric acid.
34. Explain steam distillation using an example.
35. Give an example for a synthetic polymer. What are the reagents for its preparation? Draw the schematic representation.
36. Differentiate thermoplastics and thermosetting plastics. Give one example for each.

Part D (Long essay type)
(Answer any 2. Weight 4)

37. Describe the different methods for concentration of ores. Explain electrometallurgy.

38. What are polymers? Explain different type of polymers based on the monomers and type of bond in them.
39. Describe different purification methods of solid and liquid compounds

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – IV

IC 1441 INORGANIC CHEMISTRY - III

Core Course – 8 Credit 4 Lecture - 4 hrs per week Total 72 hrs

Aim of the Course : To learn about d-block and f-block elements, their properties and their coordination, inorganic polymers and organometallics.

Objective of the Course : After completion, the students will understand how the transition metals coordinate, the theories of coordination, how metals combine with organic compounds to form organometallic compounds and the role of metal ions in biological systems.

Module I Transition and inner transition elements (18 hours)

(a) Transition elements

Electronic configuration and general characteristics - Comparison of 3d, 4d and 5d transition series – Colour, catalytic activities and spectral properties with reference to d^1 to d^{10} systems. Preparation, properties and uses of $K_2Cr_2O_7$, $KMnO_4$ and $TiCl_4$.

(b) Lanthanides and actinides

Lanthanides - electronic configuration and general properties – Occurrence and isolation of lanthanides from monazite – Lanthanide contraction – Magnetic properties and complexation behaviour.

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

Module II Coordination Chemistry (18hours)

Nomenclature – 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, M.O.Theory – Effect of crystal field splitting – CFSE – Spectrochemical series - Magnetic properties and colour of metal complexes – Application of coordination compounds in quantitative and qualitative analysis.

Module III Organometallic Compounds and Bioinorganic Chemistry (18 hours)

(a) 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 of iron and nickel – Bonding in organometallic compounds like ferrocene, dibenzene chromium, Ziese's salt – Dinitrogen complexes – Application of organometallic compounds.

(b) 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) – Photosynthesis – Sodium-Potassium pump - Biochemistry of magnesium and calcium (brief study only)

Module IV Compounds of non-transition elements (18 hours)

Manufacture and uses of the following

Glass – different types of glasses, Silicates, Zeolites and Silicones .

Inorganic Polymers

Phosphorus, boron and silicon based polymers – Structure and industrial applications.

Borax - boron hydrides, boron nitrides, borazole and carboranes.

Oxides and oxyacids of phosphorus.

Oxides and oxyacids of halogens (structure only) – Inter halogen compounds and pseudo halogens – Compounds of noble gases – Uses of noble gases.

Refractory carbides, nitrides, salt-like carbides, borides, and silicides

References:

1. Cotton and Wilkinson,"Advanced Inorganic Chemistry"
2. J.E. Huheey,"Inorganic Chemistry" .
3. Shriver and Atkins,"Inorganic Chemistry".
4. J.D.Lee,"Concise inorganic Chemistry".
5. Bosolo and Johnson,"Coordination Chemistry".
6. S. F. A. Kettle,"Coordination Chemistry".
7. M.N. Hughes**,"**Bio inorganic Chemistry".

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND

INDUSTRIAL CHEMISTRY

SEMESTER 1V EXAMINATION

IC 1441 INORGANIC CHEMISTRY - III

Time : Three Hours **Weight: 30**

Section A, Weight 1 each (answer in a word\sentence)

Answer all questions

I. 1. Which is more basic; $La(OH)_3$ or $Lu(OH)_3$?
   2. Give the general outer electronic configuration of a transition element.
   3. Which is the catalyst used in the oxidation of SO_2 to SO_3 in contact process ?
   4. Name the element obtained by the bombardment of ^{238}U with an a – particle.

II. 5. What is the coordination number of Ag in $[Ag(CN)_2]$?
   6. Give the IUPAC name of $Na_3[Co(CO_3)_3]$.
   7 What is the unit of magnetic moment ?
   8. Give the example for a tridentate ligand.

III. 9. Write the structure of ferrocene
   10. Give the formula of a metal carbonyl which does not obey 18-electron rule.
   11. Name the metal ion, other than magnesium, involved in photosynthesis.

12. Name a protein, containing calcium.

IV. 13. Give an example of phosphorus based polymer.

14. What is 'inorganic graphite' ?

15. What is the oxidation number of P in H_3PO_4 ?

16. Give the formula of a methanide. **1×4 = 4**

Section B (short answer type) Weight 1 each

(Answer any 8 questions from the following,)The answer must contain 4 points.

17. Transition metals are less reactive than the alkali and alkaline earth metals - Justify.
18. Which is more stable: Cu^{2+} or Cu^{+} in aqueous solution. ? Substantiate your answer.
19. Which has got greater tendency to form complexes; lanthanides or actinides ? Give reasons.
20. What is chelate effect ?
21. What is an ambidentate ligand ? Give example.
22. Explain geometrical isomerism in metal complexes with suitable example.
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. What are zeolites ? Mention their uses.
28. What happens when orthophosphoric acid is heated ? **1×8 = 8**

Section C (Short essay type) Weight 2 each

(Answer any 5 questions from the following. The answer must contain 8 points)

29. Starting from pyrolusite, how $KMnO_4$ is prepared ?
30. What is lanthanide contraction ? Explain its consequences .
31. What are the factors that affect stability of metal complexes ?
32. Give an account of the applications of coordination compounds in quantitative and qualitative analysis.
33. Discuss the nature of bonding in metal carbonyls.
34. Give an account of sodium-potassium pump in biological systems.
35. How silicones are prepared ? Discuss their structure and uses.
36. Compare the properties of borazole with those of benzene. **2×5 = 10**

Section D (long essay type)

(Answer any 2 questions. Weight 4)

37. Describe the ion exchange method for the separation of lanthanides from monazite. Comment on the magnetic properties of lanthanides.
38. Describe the splitting of d-orbitals in tetrahedral and octahedral fields according to crystal field theory.
39. Give an account of the preparation, properties, structure and bonding of noble gas compounds. **4×2 = 8**

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – IV

IC 1442 PHYSICAL CHEMISTRY – II

Core Course – 9 Credit-4 Total: 72 hrs Lecture - 4 hrs per week

Aim of the Course: The aim of the course is to make the students aware of quantum mechanics, statistical thermodynamics, spectroscopic and non-spectroscopic methods of studying molecules and adsorption phenomena.

Objective of the Course : This course introduces the basics of the developing fields such as spectroscopy, quantum mechanics and statistical thermodynamics **.**

Module I – Thermodynamics III & Statistical thermodynamics (12 hours)

Nernst heat theorem, proof and its consequences. Statement of IIIrd law-Plank's statement, Lewis Randall statement. Concept of perfect crystal, evaluation of absolute entropies of solid, liquid and gas. Exception to IIIrd law with reference to examples- CO, NO, N_2O and H_2O

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 hours)

Colloidal state: Types of solutions – true, colloid and suspensions, Purification of colloids – ultra filtration and electrodialysis, Kinetic, optical and electrical properties of colloids. Ultra microscope, Electrical double layer and zeta potential. Coagulation of colloids, Hardy-Schulz rule. 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 Langmuir equation. Applications of adsorption.

Module III – Quantum mechanics (12 hours)

Radiation phenomena- blackbody radiation, photoelectric effect, Compton effect and atomic spectra. Planck's quantum theory and explanation of the radiation phenomena.

Schrodinger wave equation – significance of ? , 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 – I (12 hours)

Regions of electromagnetic spectrum. Different units of energy (erg, joule,

calorie, cm^{-1}, Hz, $\overset{0}{A}$ 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, effect of isotopic substitution.

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 hours)

Electronic spectroscopy: Franck-Condon principle. Singlet and triplet states dissociation and pre-dissociation. 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.

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.

Module VI – Non-spectroscopic methods & Surface properties (12 hours)

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 parachor.

Surface properties: Examination of surfaces using ESCA, Auger, Scanning Tunneling Microscopy (STM) and Scanning Electron Microscopy (SEM).

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 Castllan, “Physical Chemistry”, Narosa Publishing House
4. Puri, Sharma and Pathania, “Principles of Physical Chemistry”, Millennium Edition, Vishal Publishing Co.
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7. M C Guptha, "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 ,

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND

INDUSTRIAL CHEMISTRY

SEMESTER IV EXAMINATION

IC 1442 PHYSICAL CHEMISTRY - II

Time : Three Hours **Weight: 30**

Section A , weight 1 each(answer in one word\ sentence)

(Answer all questions)

I. 1. The migration of colloidal particles under the influence of an electric field is called ------
2. Entropy of CO at absolute zero is -----
3. The blue colour of water in the sea is due to ----------
4. Entropy related to probability as _____ .

II. 5. The Heisenberg uncertainty principle can be stated by the equation ------
6. The Laplacian operator is defined by ? ^{2} = ----------
7. Which of the following will give pure rotational spectrum?
H_2, N_2, CO_2, HCl.
8. The minimum frequency of incident light needed to eject electrons from the surface of the metal is called --------

III. 9. Schrodinger wave equation is _____ .
10. Give the expression for Freundlich adsorption isotherm .
11. The compound used as standard in nmr spectroscopy is _____ .
12. Give the relation between character and surface tension of a liquid .

IV. 13. Free radicals are identified using _____ spectroscopy.
14. STM is _____.

15. _____ is the unit of dipole moment.
16. The selection rule for rotational spectroscopy is _____ **1×4 = 4**

Section B, weight-1 each (short answer type)

Answer any 8 questions from the following. The answer must contain 4 points.

17. What is sedimentation?
18. Explain blackbody radiation
19. What are the postulates of quantum mechanics?
20. What is energy expression for vibrational spectrum? Explain the terms
21. Give a method for the determination of absolute entropy of a gas.
22. Explain chemical shift
23. What is hyperfine splitting in esr?
24. What are the applications of mass spectrometry?
25. How is magnetic susceptibility measured?
26. What is zeta potential ?
27. Calculate the number of fundamental modes of vibrations of CO_2 and SO_2 molecules.
28. How does stokes and anti stokes lines originate in Raman spectrum. **1×8 = 8**

Section C, weight 2 (Short essay type)

Answer any 5 from the following. The answer must contain 8 points.

29. What is an ensemble, explain the different types of enzembles.
30. Explain (1) inbibition(2) syneresis (3) micelles (4) CMC
31. Apply quantum mechanics to particle in a one dimensional box.
32. Explain mutual exclusion rule with examples.
33. Explain the spin-spin coupling and high resolution spectra in nmr with an examble.
34. What is Debye equation ? Explain its significance.
35. What are the consequences of unharmonicity in vibrational spectroscopy?
36. The fundamental vibrational frequency of carbon monoxide molecule is 2170. cm^{-1} Calculate the force constant of the molecule. **2×5 = 10**

Section D, Weight-4 each (Long essay type)

Answer any two from the following

37. What are thermodynamic functions in terms of partition functions?
38. Derive Langmuir adsorption isotherm and explain the determination of surface area of a solid by it.
39. How is bond length determined by rotational spectroscopy?

The pure rotational spectrum of a gaseous molecule CN consists of a series of equally spaced lines separated by $3.7978 cm^{-1}$. calculate the internuclear distance of the molecule. The molar masses are; $^{12}C=12.011$ and $^{14}N=14.007$ g mol^{-1}

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – IV

INDUSTRIAL CHEMISTRY II COURSE CODE –IC1471

Vocational Course-3 Credits 4 Total 54 Hrs Lectures: 3Hrs per week

Module I - 9 Hrs

Unit process, unit operations, flow diagrams, Energy balance and material balance (basic concepts only.)

Fuels , calorific value, Basic concepts of I S O

Fluid flow, stream line flow. Turbulent flow, viscosity –Reynold's number.

Newtonian and non Newtonian liquids. Heat transfer. Types of heat exchangers.

(Shell type and plate type.)

Refrigeration cycles. Safety in chemical industry. First aids.

Module II 9 Hrs

Basic concepts –branched and network polymers. Classification and nomenclature .Properties of polymers. Mol wt. glass transition temperature solubility and viscoelasticity. Manufacture and users of PF resins. Importance of polymers in controlled drug delivery and packaging.Polymer processing, compounding (blending, moulding, casting, drawing, rolling)

Composites classification, micro and nano composites.

Conducting polymers. PA, PPP, PPg(SN)x etc. Synthetic inorganic polymers, silicones, polyphosphazenes,-manufacture and application

Module III 9Hrs.

Soaps and detergents-Basic chemical compositions of soaps, manufacture(Cold, semi boiled and full boiled processes)

Surface active agents, builders, additives, fillers. Basic concepts of perfuming and colouring. Bio-degradability.

Cosmetics –basic concepts –composition –production and classification of creams – sunscreen and suntan lotions –deodorants talcum powder –dentifiers, lipsticks.

Module IV 9 Hrs

Food processing –colouring and flavouring agents, food preservation –viscosity builders –bulking agents, artificial sweetners – food adulteration –packaging and catering.

Module V 9 Hrs

An overview of technical sampling of solids, liquids and gases. Fundamental concepts or theory and industrial application of particle size analyzer spectrophotometry –flame, photometry –AAS -Xray flouorescence ion selective electrodes –chromatography.

Module VI 9 Hrs

Basic Concepts,

Classification –methods of dyeing –acid –direct -reactive –disperse –vat cationic sulphur –indigo –azo phthalocyanine –dyes. Synthetic Dyes A brief idea of metal

complex dye stuffs. (introduction to natural dyes and it's importance in cotton textile dyeing.) fluorescent and brightening agents –hair dyes –dyeing standards and Health hazards.
Paints –varnishes and lacquers.

References. :

1. *Nano Science And Technology*.- V.S Muraleedharan –A Subramannian –Ane books put Ltd –(Page 1 to
2. *Unit process and chemical engineering*- Chathopadhyaya
3. *Chemical Process Principles* – Hougens
4. *Industrial Chemistry* – B K Sharma
5. *Cosmetics preparation and practice* – Vandana publications
6. *Hand book of cottage industries* – Small Business publications

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND

INDUSTRIAL CHEMISTRY

SEMESTER IV EXAMINATION

IC 1441 INDUSTRIAL CHEMISTRY II

Time : Three Hours **Weightage: 30**

SEMESTER V

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1541 ORGANIC CHEMISTRY – II

Core Course No. 11 Credit-4 Total Hrs: 72 Lectures per week: 4

Lecture - 4 hours per week

Aim of the Course : The syllabus deals with organic compounds like ethers, acids, carbohydrates, aminoacids, proteins, nucleic acids, oils, fats, detergents, vitamins, terpenes, alkaloids, hormones and enzymes and their properties and the stereochemistry of organic compounds.

Objective of the Course : The students will get an interesting idea about the stereochemistry of organic compounds and the preparation and properties of organic compound

Module. I Ethers, Carboxylic acids and their derivatives [12Hrs.]

Ethers: - Preparation and properties. Zeisel method of estimation of alkyl group. Brief Study of epoxides and crown ethers. Carboxylic acids and their derivatives: - Preparation and properties of aliphatic and aromatic carboxylic acids. Ascent and descent series in aliphatic carboxylic acids. Effect of substituents on acidity of aliphatic and aromatic carboxylic acids. Preparation, properties and uses of anthranilic acid, cinnamic acid, lactic acid, salicylic acid, adipic acid, acid anhydrides, amides, esters, coumarin, malic acid, tartaric acid and citric acid.

Module II Carbohydrates [12hrs.]

Classification and Nomenclature of monosaccharides. Configuration of monosaccharides. Preparation, properties and structural elucidation of glucose, fructose and sucrose. Anomers, epimers and mutarotation. Mechanisms of Epimerization and Mutarotation. Ascent and descent series in aldoses and ketoses. Conversion of aldoses to ketoses and ketoses to aldoses. Conversion of glucose to mannose.

Polysaccharides: - Starch and Cellulose - Preparation, properties and structure of starch and cellulose (structural elucidation not expected). Industrial application of cellulose.

Module III Amino acids, Proteins and Nucleic acids [12 hrs.]

Amino acids: - Classification, structure and stereochemistry of amino acids, essential and non essential amino acids, zwitter ion, isoelectric point, General methods of preparation and reactions of a - amino acids. Peptides: structure and synthesis (Carbo benzoxy method, Sheehan method only).

Proteins: - Structure of proteins, denaturation and colour reactions.

Nucleic acids: - Classification and structure of DNA and RNA. Replication of DNA, Genetic Codes.

Module IV Oils, Fats, Detergents, Alkaloids and Terpenes [12 hrs.]

Oils and Fats: - Occurrence and extraction. Common fatty acids, soap, saponification value, iodine value, acid value, synthetic detergents and detergent action, alkyl and aryl sulphonates.

Alkaloids: - Extraction and structural elucidation of conine, nicotineand importance of quinine, morphine and codeine.

Terpenes: - Essential oils, isolation of citral and geraniol (No structural elucidation) Isoprene and special isoprene rule.

Module V Vitamins, Hormones, Enzymes and Synthetic reagents [12hrs.]

Vitamins: - Classification and important sources, physiological action and deficiency symptoms of vitamin A, B_1, B_2, and B_{12}. C, D, E and K.

Hormones: - Introduction, steroid and sex hormones – examples and functions (Structure not expected).

Enzymes: - General nature and classification, specificity of enzymes.Synthetic reagents: - Acetoaceticester-synthesis and tuatomerism-syntheic application of Acetoaceticester, Synthesis and synthetic application of Diethylmalonate. Grignard reagents, organic zinc reagents, Reformatsky reaction.

Module VI Stereochemistry of Organic Compounds. [12hrs.]

Optical isomerism: elements of symmetry, chirality, steriogenic centre, enantiomers, chiral and achiral molecules with two stereogenic centres, dia stereo isomers, meso compounds, resolution, inversion and racemization reaction. Aymmetric synthesis, absolute configuration, sequence rule, D-L, R-S systems of nomenclature. Optical activity of compounds having no chiral carbon (Allenes and Biphenyls).

Geometrical isomerism: E - Z systems of nomenclature. Geometric isomerism in maleic and fumaric acid and butadiene.

Conformational isomerism: Configurational analysis of ethane, n – butane and cyclohexane. Newmann projection formula and Sawhorse formula.

References

1 Morrison & Boyd,"Organic Chemistry". :

2 F. Carey, Mc Graw Hill,"Organic Chemistry". :

3 I.L. Finar, "Organic Chemistry", Vol I & II Longmann.

4 L.G. Wade, "Organic Chemistry".

5 P.Y. Bruice,"Organic Chemistry".

6 Stanley, H. Pine, Mc Graw Hill,"Organic Chemistry".

7 Jerry March,"Advanced Organic Chemistry".

8 S.M. Mukherji and S.P. Singh, " Reaction Mechanism in Organic Chemistry" Mac Millan.

9. Rein hard Bruckner ,"Advanced Organic Chemistry Reaction Mechanism".

10 Bahl & Bahl," Advanced Organic Chemistry".

11 Tewari, Mehrotra," A text book of Organic Chemistry".

12 M.K. Jain ,"Principles of Organic Chemistry".

13 Fieser & Fieser," Advanced Organic Chemistry".

14 D. Nasipuri, "Stereo Chemistry of Organic compounds" .

15 Arun Parikh, Hansa Parikh, Khyati Parikh ,"Name Reactions in Organic Synthesis".

MODEL QUESTION PAPER

BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY AND INDUSTRIAL CHEMISTRY

SEMESTER V EXAMINATION

IC 1541 ORGANIC CHEMISTRY – II

Time : Three Hours Weight : 30

Section A, Weight 1 each (answer in a word\sentence)

Answer all questions

I 1. What is the product formed when alkyl halide is treated with sodium ethoxide?

2. Arrange the following acids on the increasing order of acid strength.
(a) formic acid (b) acetic acid (c) propionic acid

3. Write the chemical formula of anthranilic acid.

4. Write the product formed when acetic acid is treated with Cl_2 in presence of red phosphorous.

II 5. The light vibrating in only one plane is called _____.

6. _____ carbon atom of lactic acid(CH_3-CHOH-COOH) is asymmetric.

7. Racemic mixture is optically _____.

8. _____ conformation of cyclohexane is more stable.

III 9. The specific rotation of ß D glucose is _____

10. Sucrose on hydrolysis gives_____

11. Linear polymer of glucose units present in starch is known as _____
12. Guncotton is _____.

IV. 13. What is the basic unit of protein ?
14. Write the structure of optically inactive amino acid.
15. Which vitamin is known as Ascorbic acid?
16. Give the name of any one female sex hormone. **1×4 = 4**

Section B, Weight 1 each (short answer type)

Answer any 8 from the following. The answer must contain 4 points.

17. How can you prepare Nylon 6,6.
18. Write a short note on industrial application of cellulose.
19. What is meant by mutarotation.
20. What are the differences between RNA and DNA?
21. Write a short note on zwitter ion property of amino acids..
22. Write a note on Reformatsky reaction.
23. Define saponification value and iodine value.
24. Draw the Newmann and Sawhorse projection formulae of different confirmation of ethane.
25. Write a short note on geometrical isomerism of butadiene.
26. What are essential oils? Give an example.
27. What is meant by isoelectric point?
28. Give the sources of vitamins C, K, A and D. **1×8 = 8**

Section C, Weight 2 each (Short essay type)

[Answer any 5 of 8 questions] The answer must contain 8 points.

29. How can you convert CH_3Cl to a-hydroxy acetic acid?
30. Write a note on benzoin condensation with the help of its mechanism?
31. How can you convert arabinose to glucose?
32. Write a note on Strecker synthesis at amino acid?
33. Discuss the importance of Quinine, Morphine and Codeine?
34. Write a short note on elements of symmetry.
35. Distiguish between anomers and epimers.
36. Explain geometrical isomerism. **2×5 = 10**

Section D, weight 4 each (long essay type)

[Answer any two out of three questions]

37. (1) What is Coumarin ? How can you prepare that ? What are its uses?
(2) How can you prepare Salicylic cid by (i) Riemer- Tiemann and (ii) Kolbe's reactions?
38. i. What is the product firmed when glucose is treated with excess of phenyl hydrazine? Write the mechanism.
ii. What are enzymes? How can they be classified? Write a note on specificity of enzymes.
39. i. Write any four synthetic applications of acetoacetic ester with relevant equations.
ii. Explain the optical isomerism in tartaric acid. **4×2 = 8**

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1571 INDUSTRIAL CHEMISTRY- III

Vocational Course -5 Credit-4 Total Hrs : 36 Hrs Lecture -2 hrs per week

Aim of the Course; The students are expected to acquire knowledge about synthesis of organic compounds, the preparation and properties of organic sulphur and nitrogen compounds, types of polymers, their synthesis and applications and organic spectroscopy.

Objective of the Course : By studying this part the students get an idea of polymerization and organic spectroscopy.

Module –I Organic Synthesis, Rearrangements, Synthetic Polymers and Dyes- 9Hrs

Study of reactions and mechanisms of Meerwin-Pondorf- Verley reductions, Gattermann-Koch reaction, Gattermann aldehyde synthesis, Claisen condensation, Knoevenangal reaction , Perkin reaction, Cannizaro reaction, Reimer-Tiemann reaction, Sandmeyer reaction & Wittig reaction.

Mechanism of Pinacol- Pinacolone rearrangement, Claisen rearrangement, Fries rearrangement, Benzidine rearrangement and Beckmann rearrangement.

Module – II Polymers- 9Hrs

Types of polymerization- addition, condensation and coordination polymerization. Zieglar –Natta catalyst. Synthesis and applications of urea – formaldehyde resins, Bakelite, polythene, PVC, PMMA, Nylon-6,6. Natural and synthetic resins. Buna-N , Buna-S, Neoprene, Polystyrene. Biodegradable polymers- two examples- starch and cellulose. Number average molecular weight and weight average molecular weight of polymers. Composites(refer any two)

Dyes- Theory of colour and constitution, classification of dyes, synthesis of methyl orange, congo red, malachite green, crystal violet, phenolphthalein, fluorescein, alizarin and indigo

Module –III Organic Sulphur compounds 9 Hrs

Aromatic sulfur compounds –Preparation and applications of benzene sulphonic acids, toluene sulphonic acid, benzene sulphonyl chloride, sulphanilic acid , sulphanilamide and sulpha drugs- sulphapyridine, sulphathiazole, sulphadiazine, sulphaguanidine and sulphaacetamide.

Module- IV Organic Nitrogen Compounds 9 Hrs

Nitro compounds- preparation of nitroalkanes and nitroarenes, tautomerism, reduction of nitrobenzene in acid , base and neutral medium. General methods of preparation and reactions of aliphatic and aromatic amines, classification of amines, separation of mixture of amines, methods to distinguish primary, secondary and tertiary amines, basicity of amines, effect of substituents , quarternary ammonium compounds- Hofmann elimination. Diazonium and diazo compounds- preparation, structure and their synthetic importance.

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1572 INDUSTRIAL CHEMISTRY- IV

VOCATIONAL COURSE -6 CREDIT – 4 TOTAL HRS – 36 LECTURE- 2 HRS PER WEEK

Module 1- Heterocyclic compounds 9 Hrs

Introduction, classification of heterocyclic compounds, nomenclature, aromaticity, preparation and properties of furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline, pyramidine, purine and indole.

Structural elucidation of pyrrole, pyridine and indole.

Importance of heterocyclic compounds in medicine and biochemistry.

Mechanism of electrophilic substitution in indole, quinoline and isoquinoline

Module II 9Hrs

Classification of Drugs Classification of various types of drugs with examples. Rational drug design and synthesis, salicylic acid and its derivatives, Ibuprofen.

Principles of green chemistry.

ModuleIII – Organic Spectroscopy 9 Hrs

UV-Visible Spectroscopy- absorption, types of electronic transitions, effect of conjugation, concept of chromophore, auxochrome, bathochrome, hypochromic shifts, hyperchromic and hypochromic effects. UV-Visible spectra of enes. Calculation of ?max.

IR Spectroscopy- molecular vibrations, factors influencing vibrational frequencies, inductve effect and hydrogen bonding. Finger print region and interpretation of IR spectra of simple organic molecules such as phenol, acetone, acetanilide, benzaldehyde.

Module IV - NMR spectroscopy 9 Hrs

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 ethylbromide, pure ethanol and impure ethanol(acidic impurities), acetaldehyde and toluene. Basic knowledge of C^{13} NMR

Mass spectrometry- Theory of mass spectrum, base peak and molecular ion peak, types of fragmentation, Mclafferty rearrangement, isotopic effect. Applications- determination of molecular mass.

References :

1. Bahl & Bahl ,"Advanced Organic Chemistry".
2. Tewari & Mehrotra ,"Advanced Organic Chemistry".
3. M K Jain ,"Principles of Organic Chemistry".
4. Fieser & Fieser ,"Advanced Organic Chemistry".
5. Jerry March," Advanced Organic Chemistry".
6. Morrison & Boyd ,"Organic Chemistry".
7. I L Finar ,"Organic Chemistry" Vol I & II.
8. L G Wade," Organic Chemistry".
9. S M Mukherji & S P Singh ,"Reactions , Mechanisms of Organic Chemistry".
10. Peter Sykes ,"Organic Chemistry".
11. Kemp, W. Organic Spectroscopy
12. Jag Mohan Organic Spectroscopy

OPEN COURSE FOR OTHER MAJORS
CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1551.1 ESSENTIALS OF CHEMISTRY

Open course 1. Credit-2 Lecture – 3 hrs per week Total 54 hrs

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, Auf bau principle, Hund's rule; Pauli's exclusion principle. Electronic configuration of atoms- half and completely filled orbitals. Hybridisation: simple types with example.
Modern periodic tables: Periods, Groups, Periodicity- valancy, 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(elementary idea only). Nuclear fission and Nuclear fusion. Rock dating- Radio carbon dating.
Module 3 : Polymer Chemistry (9 hrs)
Classification of polymer: Origin, structure, synthesis, Molecular forces. Commercially important polymers: structure and application of polyethylene, polystyrene, polyhaloolefines, Nylon-6, Nylon-66, Melamine, Terylene, Bakelite, Natural and synthetic rubber, vulcanization, inorganic polymer: (Example 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.
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 nonionic detergents, cleansing action of soaps,
Explosives: TNT, TNG, RDX, Gun cotton: name, structure and action

Module 6 : Environmental Chemistry (9hrs)
Air Pollution: Types of pollutant in air- carbon monoxide, carbon dioxide, Nitrogen oxides, Sulphur dioxides, hydrogen sulphide, Cl_2, 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. Graw Hill ,"Organic Chemistry" Inc.
6. I.L Finar,"Organic Chemistry", Vol. 1 Longman
7. Tewari, Mehrotra- Vikas & Vishnoi,"A Text book for Organic Chemistry:
8. M.K. Jain," Principles of Organic Chemistry".
9. A.K. Dey,"Environmental Chemistry".

MODEL QUESTION PAPER

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1551.1 ESSENTIALS OF CHEMISTRY

Time : Three Hours **Total Weight : 30**

Section A, Weight 1 each (answer in a word \ sentence)

Answer all questions

I 1. One orbital can accommodate a maximum of_____electrons.
2. _____states that orbitals are filled in the increasing order of energy.
3. There are _____quantum numbers.
4. The shape of s orbital is _____.

II 5. Who discovered radioactivity?
6. What is the mathematical expression for the half life period of a 1^{st} order reaction?
7. Name any unit of radioactivity.
8. Who proposed Group Displacement law?

III. 9. Bakelite is a polymer of phenol and _____.
10. Monomer of Nylon 6,6 is _____.
11. An example of an inorganic polymer is _____.
12. Name any compound which causes acid rain.

IV. 13. Name an enzyme.
14. Write an example of a sex hormone.
15. What is the expansion of DNA?
16. Write an example for a dye. **1×4 = 4**

Section B, Weight 1 each (Short answer type)

Answer any eight questions from the following. The answer must contain 4 points.

17. Name the pollutants in air?
18. What are the factors affecting the purity of water?
19. Explain Hund's rule of maximum multiplicity with an example.
20. Define electron affinity, explain with an example.
21. Distinguish between half life period and average life period.
22. Explain artificial radioactivity.
23. Write the structure and applications of polyhalo olefins.
24. What is vulcanization of rubber?
25. What are corticosteroidal hormones? Explain with example.
26. Distinguish between DNA and RNA.
27. How are dyes classified?
28. Explain cleansing action of soap. **1×8 = 8**

Section C, Weight 2 each (Short essay type)

Answer any five questions from the following. The answer must contain 8 points.

29. Explain the source and hazards of fly ash and asbestos.
30. Explain briefly soil pollution.
31. What are periods and groups in the periodic table? What is periodicity?
32. Explain hybridization with examples.
33. Distinguish between nuclear fission and nuclear fusion with examples.
34. What are Nylon 66, Melamine and Terylene?
35. What are the functions and deficiency diseases of Vitamin C, Vitamin D and Vitamin E.
36. Write a note on explosives. **2×5 = 10**

Section D, Weight 4 each (Long essay type)

Answer any two questions.

37. Write an essay on plastic waste and long term use of fertilizers.
38. What are quantum numbers? Explain.
39. Explain Group Displacement law and radioactive decay series. **4×2 = 8**

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1551.2 PETROCHEMICALS

Open Course 2 Credit-2 Lecture 3 hours per week Total 54hrs

Module I: Introduction 9hrs

Introduction to crude oil , transportation of crude oil, constitution of crude oil, natural gas . distillation of crude oil, separation of natural gas and different fractions based on relative volatilities, compositions of different distillates. Meaning of terms such as viscosity reducers, ignition point , flash point, octane number, doctor solution

Module II: Types of Hydrocarbon Oils 9hrs

Types of hydrocarbon fuels and their characteristics. Detailed discussion of the following operations with respect to process, mechanism , catalyst used and applications, cracking- catalytic cracking hydrocracking, isomerisation, reforming, alkylation, petroleum coke and nitrogen compounds from petroleum.

Module III: Manufacture and preparation of certain compounds-I 9hrs

Manufacture of the following compounds: methane, ethylene, acetylene, propylene,C-4hydrocarbons, higher olefins. Preparation of the following from methane-methanol, carbon black. Preparation of the following from ethylene-ethylchloride, ethanol, ethyleneoxide, ethylene glycol, acetaldehyde, acetic aid, styrene, vinyl acetate.

Module IV :Manufacture and preparation of certain compounds-2 9hrs

Manufacture of the following from propylene: isopropanol, cumene, glycerene, acrylonitrile. Manufacture of the following from acetylene: vinylchloride, chloroprene, acetonitrile, acetaldehyde.

Module V : Manufacture and preparation from certain compounds-3 9hrs

Manufacture of the following from C-4hydrocarbons: butadiene, isobutene, butanediols, oligomers. Manufacture of aromatic compounds- benzene, toluene, xylene, naphthalene.

Module VI : Catalyst in Petrochemical Industry 9hrs

Various catalysts used in petrochemical industry, their preparation , structure, applications and selectivity, importance of petroleum and petroleum industry in the context of Indian economy. .

References

1. H. Steiner, "Introduction to petroleum chemicals",Pergaman Press
2. Spitz,"Petrochemicals- the vise of an Industry", Wiley
3. I.F. Hatch and S. Mater, "From Hydrocarbones to Petrochemicals", Gulf Publishing Company, Houston.
4.

Model Question

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1551.2 PETROCHEMICALS

Time : Three Hours **Total Weight : 30**

Section A, Weight 1 each (answer in a word \ sentence)

Answer all questions

I 1. Doctor solution is _____

2. Water gas is a mixture of Hydrogen and_____

3. Styrene is _____

4. Carbon black is _____

II 5. Name the final residue of distillation of petroleum.

6. An example of a poly nuclear hydrocarbon.

7. Name the catalyst used in petrochemical industry.

8. Name the catalyst used in hydrocracking.

III. 9. A higher olefin is _____

10. Structure of ethylene glycol is _____

11. An oligomer is _____

12. The structure of acetonitrile is ____

IV. 13. Write the structure of cumene .

14. Benzene is obtained by the polymerization of _____ .

15. Write the structure of para- xylene?

16. Give the structure of chloroprene. **1×4 = 4**

Section B, Weight 1 each (Short answer type)

Answer any 8 questions from the ollowing. The answer ust contain 4 points.

17. Define flash point.

18. What is octane number?

19. Explain catalytic cracking.

20. What nitrogen compounds are obtained from petroleum?

21. How is methanol prepared from methane.

22. How is ethylchloride obtained from ethylene?

23. How is cumene prepared from propylene?

24. How is acetylene converted to acetaldehyde?

25. Write examples of C-4 hydrocarbons.

26. How is xylene prepared?

27. What are the characteristic of hydrocarbon fuels?

28. Explain the terms (1) Viscosity reducers (2) Ignition point **1×8 = 8**

Section C, Weight 2 each (Short essay type)

Answer any 5 questions from the following. Theanswer must contain 8 points.

29. Explain the manufacture of maphthalene.
30. How are the following conversions effected ?(1) ethylene to ethyl chloride (2) ethylene to ethanol
31. Explain alkylation and reforming.
32. Explain the manufacture of methane and propylene.
33. What is ethylene oxide. How is it prepared?
34. How are chloroprene and vinyl chloride prepared from acetylene?
35. Explain the manufacture of toluene.
36. Explain the importance of petroleum. **2×5 = 10**

Section D. Weight, 4 each (Long essay type)

Answer any two questions

37. Discuss the fractional distillation of crude oil.
38. Which are the different distillates of hydrocarbon finals and what are their characteristics?
39. What are the catalysts used in petrochemical industry? Explain their preparation, structure, applications and selectivity. **4×2 = 8**

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1551.3 PHARMACEUTICALS

Open Course 3 Credit-2 Lecture 3 hours per week Total 54hrs

Module I: Introduction 9hrs

Historical background and development of pharmaceutical industry in India in brief.

Introduction to various type of formulations and roots of administration. Aseptic conditions, need for sterilization, various methods of sterilization. Various methods of pharmaceutical excipients- their chemistry , process of manufacture and quality, specifications , glidants lubricants, diluents, preservatives, antioxidants, emulsifying agents, coating agents, binders, colouring agents, flavouring agents and other additives, sorbitol, mannitol , viscosity builders etc.

Module- II: Phytochemicals and evaluation of crude drugs 9hrs

Phytochemicals-introduction to plant classification and crude drugs, cultivation, collection, preparation for the market and storage of medicinal plants

Evaluation of crude drugs- Moisture content, extractive value, volatile oil content, foreign organic matter, crude fibre content.

Module –III: Chemical constitution of Plants,. isolation procedure and quality control 9hrs

Chemical constitution of plants-including carbohydrates, aminoacids, proteins, fats, waxes , volatile oils, terpenoids, steroids and alkaloids. Various isolation procedures for active ingredients with example for alkaloid eg. Vinca alkaloids, reserpine, for steroids- sapogenin, diosgenin. Parmaceutical quality control- sterility testing, pyrogenic testing, glass testing.

Module-IV: Antimicribial, Antipyretic, Antifungal, Analgesic and Antihistamine drugs 9hr

Synthesis and uses of

a) Sulpha drugs- sulphaguanidine
b) Antimicrobial- acetaminophen
c) Analgesic- salicylic acid and brufan
d) Antipyretic- paracetamol
e) Antihistamine-cetrizine

Structure of typical examples of sulpha drugs

Module V: Hormons,Vitamins, Cardiovasular drugs and beta- Blockers 9 hrs

Synthesis and uses of

a] Cardiovascular drug- sorbitrate
b)Beta blockers- propranol
c) Vitamins- Vitamin A, Vitamin C
c) Steroidal hormones- testosterone
d) Barbiturates-penobarbital

Structure of typical exaples of Cardiovascular drugs

Module VI: Drugs from fermentation 9hrs

Drugs from fermentation processes- microorganisms, types, growth and usefulness, enzyme involved in fermentation, microbial products. General principle of fermentation processes and product processing. Manufacture of antibiotics-Penicillin G and semi synthetic penicillins, tetracycline ,Vit. B12. Enzyme catalysed transformation in drugs

Reference

1. Ramchand" ,Modern Pharmcognosy", Mc Graw Hill
2. Indian Pharmacopoea 1985
3. Jayashee Ghosh, S Chand,"Atext book of pharmaceutical chemistry", (2003)
4. I L Finar,"Organic Chemistry", Vol I & II

MODEL QUESTION PAPER
CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1551.3 PHARMACEUTICALS

Time : Three Hours **Total Weight : 30**

Section A, weight, 1 each (answer in a word \ sentence)

Answer all questions

I 1. Name a phytochemical .
2. An example of anti oxidant is _____
3. Example of disaccharide is _____
4. An example of flavouring agent is ____

II 5. Write the name of a glidant.
6. Name one colouring agent.
7. Give the name of one coating agent.
8. Name one preservative.

III. 9. The basic unit of protein is ____
10. An example of volatile oil is _____
11. An example of an alkaloid is _____
12. _____ is an example of cardiovascular drug.

IV. 13. An example of a sulphadrug.
14. Name a vitamin which contain metal atom.
15. Name a beta-blocker.
16. Give an example of antihistamine **1×4 = 4**

Section B, Weight 1 each (Short answer type)

Answer any eight questions from the following. The answer must contain4 points.

17. Define fermentation.
18. What is semisynthetic pencillin
19. What are preservatives?
20. Distinguish between sorbitol and manitol.
21. Distinguish between sterility testing and pyrogenic testing
22. What are the methods of sterilisation?
23. Define moisture content and extraction value.
24. Explain quantitative extraction of starch.
25. What are terpenoids?
26. Explain the pharmaceutical quality control.
27. Explain the manufacture of a steroidal hormone.
28. What are anti histamines? **1×8 = 8**

Section C, Weight 2 each (Short essay type)

Answer any five questions from the following. The answer must contain 8 points.

29. Explain the chemistry of coating agents and flavouring agents .
30. Whatarethemethodsofsterilisation?
31. Explaintheterms,moisturecontent,extractivevalueandvolatileoilcontent
32. What are terpenoids, steroids and alkaloids.
33. What are anti inflamatory, analgesic and antimicrobial drugs?
34. Explain manufacture of penicillins.
35. What is enzyme catalysed transformation ?
36. What are chemical constitution of plants? **2×5 = 10**

Section D, Weight 4 each (Long essay type)

Answer any two questions

37. Write an essay on classification of drugs.
38. Write notes on (a) Vinca alkaloids (b) diosgenin (c) sapogenin and (d) glass testing.
39. Explain general principle of fermentation processes and product processing.

4×2 = 8

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1551.4 DYES

Open Course 3 Credit-2 Lecture 3 hours per week Total- 54hrs

Module I :Chemistry of Intermediates-I 9hrs

Introduction to the history of dyes, natural to synthetic dyes, Benzene intermediates- chloronitrobenzenes, nitroanilines, bromonitroanilines, nitroanisoles, toluene and xylene intermediates, xylidines, diaminobenzenes, .Naphthalene intermediates- H and J-acid, N W –acid ,Chicago acid , Schaffer R and G acid .Naphthols.

Module II :Chemistry of Intermediates -2 9hrs

Anthraquinone intermediates , 1-amino and 2-amino anthraquinones, bromamine acid quinazirin, methyl and methyamino anthraquinones, disperse dye intermediates, acid-base intermediates

Module III : Chemistry of Dyes 1 9hrs

Introduction, classification of dyes on the basis of structure and the mode of application to the fibre. Colour and chemical constitution of dyes. Chemistry of dyes with respect to general structural features, mode of application to fibre, colour shades, synthesis of typical dyes, uses.

Module IV : Chemistry of Dyes 2 9hrs

Azodyes-acid, acid mordant. Basic dyes, anthraquinone dyes , reactive dyes, disperse dyes, optical whiteners-Cyanuric chloride based optical whiteners.

Module V : Analysis of Dyes

Analysis of intermediates- different methods used in the analysis. Nitrite value determination, coupling value, titanous chloride reduction, chromatography, halogen content determination, iodimetry.

Module VI : Application of Dyes.

Dyeing methods for the following- direct, acid, reactive, disperse, vat, cationic, sulphur, indigo, azoics. Effluent treatment and pollution control in dye stuff industry.

References

1. H,A.Abrahart,"Dyes and their intermediates", Pergaman Press
2. Cain Thorpe and Linsteed,"Chemistry of dyes and intermediates",1960
3. I L Finar," Organic Chemistry", Vol I & II
4. D.W.Rangnekar and P.R. Singh,"An introduction to synthetic dyes", Himalaya Publication, Bombay.

MODEL QUESTION PAPER

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – V

IC 1551.4 DYES

Time : Three Hours **Total Weight : 30**

Section A (Weight 1 each)

(Answer in one word \ sentence) Answer all Questions

I 1. Anisole is _____.
2. Quinazirine is _____ .
3. A synthetic dye is _____.
4. J- acid is _____.

II 5. Chicago acid is _____
6. Write the structure of Schaffer R acid
7. Write the structure of anthraquinone.
8. Name one mordent.

III 9. An optical whitener is ____.
10. Direct titration using iodine is _____.
11. A natural dye is _____.
12. Xylidines are ____.

IV 13. Name one acid-base intermediate.
14. Write the structure of Cyanuric acid.
15. Name one vat dye.
16. Name one anthraquinone intermediate. **1×4 = 4**

Section B (weight 1 each) (short answer type)

Answer any eight from the following. The answer must contain 4 points.

17. Write a note on synthetic dyes.
18. What are N and W acids?

19. Explain disperse dye intermediate.
20. What are acid dye intermediates?
21. Classify the dyes on the basis of mode of application on the fibre.
22. Write note on colour shades.
23. What are basic dyes?
24. Explain optical whiteners.
25. Describe titanous chloride reduction.
26. Explain coupling value.
27. Explain direct method of dyeing.
28. What is effluent treatment ? **1×8 = 8**

Section C (Weight 2 each) (short essay type)

Answer any five from the following. The answermust contain 8 points.

29. What are Xylidine intermediates?
30. Write notes on 1-amino and 2-amino anthraquinones.
31. Explain colour and chemical constitution of dyes.
32. Discribe the chemistry of dyes with respect to general structural features?
33. Explain the synthesis of vat dyes and their uses.
34. Explain different methods used in the analysis of intermediates.
35. What are the dyeing methods used?
36. Write notes on acidic and basic dyes. **2×5 = 10**

Section D (Weight 4 each) (essay type)

Answer any two

37. Write in detail the application of dyes.
38. Explain the synthesis of typical dyes and their uses.
39. Explain the methods adopted for pollution control and effluent treatment in dye stuff industry. **4×2 = 8**

SEMESTER VI

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1641 PHYSICAL CHEMISTRY- III

Core Course-13 Credit-4 Total 72 hrs Lecture -: 4Hrs per week

Aim of the Course: This syllabus deals with kinetics of reactions, chemical and ionic equilibria, phase equilibria, binary liquid systems, catalysis and photochemistry, electrical conductance and electromotive force.

Objective of the Course: The students get a clear idea of conductance, emf, phase equilibria, rate of reactions and binary liquid mixtures.

Module I: Chemical Kinetics 12 hrs

Order of reaction, Derivation of integrated rate equation of zero, first, second and third order reactions, n^{th} order reaction, determination of order of reactions:- Graphical and analytical methods using integrated rate equations, Fractional life- method, Differential rate equation method, Isolation method. Types of complex reactions:- (a) opposing reactions (b) consecutive reactions (c) parallel reactions (d) chain reactions (explanation and examples only).

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, collision theory of unimolecular reactions, Lindemann mechanism, steady state approximation, Theory of absolute reaction rate.]

Module II: Chemical and Ionic equilibria (12 hrs)

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, relation between Kp,Kc and Kx, Reaction isotherm, Temperature dependence of equilibrium constant , Pressure dependence of equilibrium constant, Clausius-clapeyron equations and its applications.

Ionic equilibrium : Ionic product of water, Effects of solvents on ionic strength, levelling effect, Pk_a and Pk_b values, solubility product and common ion effect and their applications, pH and its determination by indicator methods, buffer action, Henderson's equation , 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:- $FeC1_3$-H_2O system and Na_2SO_4-H_2O system (e) solid–gas system- decomposition of $CaCO_3$, dehydration of $CuSO_4.5H_2O$, deliquescence and efflorescence.

Module IV: Binary liquid systems & catalysis (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, Theory of steam distillation, distribution law, its thermodynamic derivation, limitations of distribution law, application of distribution law to the study of association and dissociation of molecules, solvent extraction.

Catalysis**:-** Theories of catalysis, Intermediate compound formation theory, steady state method, Enzyme catalysis, Michaelis-Menten law.

Module V: Electro motive force (12 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 ?G, ?H and ?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, Fuel cells :- Hydrogen-Oxygen fuel cell, Hydrocarbon – Oxygen fuel cell.

Redox electrodes and redox systems, formal redox potential, principle of redox indicators, 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.

Module VI: Electrical conductance & Photochemistry (12 hrs)

Inter ionic attraction theory, Debye-Huckel-Onsager equation (Qualitative treatment only) activity and activity co-efficient 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.

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 H_2-Cl_2 reaction and H_2-Br_2 reaction, Fluorescence and phosphorescence, chemiluminescence and photosensitization, Explanation and examples.

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

References:

1. Gurdeep Raj, " Advanced Physical Chemistry" , Goel publishing house.
2. Glasstone and Lewis ,"Elements of Physical Chemistry" ,Macmillan.
3. P.C.Rakhit,"Physical Chemistry ", Sarat Book House,Calcutta.
4. K.L.K.Kapoor,"A Text book of Physical Chemistry" , Vol 1,3 & 4, Macmillan.
5. R.Stephen Berry,Stuart A. Rice & John Ross," Physical Chemistry", 2nd Edn, Oxford.
6. Levin,"Physical Chemistry" , 5^{th} edn ,TMH.
7. G.M .Barrow, "Physical Chemistry" , 6^{th} edn, The McGRAW-HILL Companie,INC.
8. Puri, Sharma & Pathania, " Priniciples of Physical Chemistry, Vishal Publishing Co.

MODEL QUESTION PAPER

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1641 PHYSICAL CHEMISTRY- III

Time : Three Hours **Total Weight : 30**

Section A, Weight 1 each

(Answer all questions in a word or sentence.)

I 1. For the chemical reaction $aA + bB \longrightarrow$ Products, the rate constant of reaction is found to be $k = [A]^l [B]^m$. The order of the reaction is.....

2. Represent the electrochemical cell formed when Zn electrode is coupled with Ag electrode.

3. Give the Arrhenius equation.

4. Write the integrated rate equation for a first order reaction.

II 5. Write Debye- Huckel- Onsagar equation.

6. Give the relation between hydrolytic constant, dissociation constant and ionic product of water of a salt of strong acid and weak base.

7. The solubility of AgCl in water at 25^0C is 0.00179 g/L. Its solubility product at 25^0C is.....

8. The pK_a values of four acids are given below. Arrange them in the increasing order of their acidity

Carboxylic acid	pK_a Value
CH_3COOH	4.80
$ClCH_2COOH$	2.86
$(CH_3)_3CCOOH$	5.05
CH_3OCH_2COOH	3.53

III 9. The expression for quantum yield of a photochemical reaction is _____.

10. The eutectic composition of Pb – Ag system is.....

11. ..... is an efflorescent substance.

12. Write the reduced phase rule equation.

IV. 13. Fractional distillation of an aqueous solution of ethanol does not give absolute alcohol, because it is

(i) an ideal solution (ii) a minimum boiling azeotrope

(iii) a maximum boiling azeotrope (iv) an acidic solution

14. Give the Nernst equation for the potential of a copper electrode.

15. The following mechanism has been proposed for the enzyme catalysis

$$E + S \underset{k_{-1}}{\overset{k_1}{<=========>}} ES \quad ; \quad ES \xrightarrow{k_2} P + E$$

Using steady state approximation for [ES], write the rate of the reaction.

16. Give an example for a system having upper cum lower CST. **1×4= 4**

Section B, Weight 1 each (short answer type)

(Answer any eight from the following) The answer must contain 4 points.

17. Define the term activation energy. Why different reactions proceed at different rates?
18. Give one example each for a consecutive and a parallel reaction
19. What is meant by common ion effect? Explain with an example.
20. Define buffer solution and buffer index .
21. Describe with example (i) Triple point (ii) Eutectic point
22. Explain the term congruent melting point with an example
23. What is critical solution temperature? How does it vary by the addition of an electrolyte?
24. What are azeotropes ? Explain with an example.
25. What is meant by liquid junction potential? How can it be almost eliminated?
26. How will you construct a calomel electrode?
27. What is Debye Falkenhagen effect?
28. Write a note on conductometric titration of acetic acid against sodium hydroxide?. **1×8 = 8**

Section C, Weight 2 each (short essay type)

(Answer any **five** questions from the following.) The answer must contain 8 points.

29. The rate constant of a second order reaction is 5.70×10^{-5} dm^3 mol^{-1} S^{-1} at 25^0C and 1.64×10^{-4} dm^3 mol^{-1} S^{-1} at 40^0C. Calculate the activation energy and the Arrhenius pre-exponential factor.
30. 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 25^0C is 1.75×10^{-5}.
31. Explain the principle of freezing mixture by taking KI – H_2O system as an example.
32. State and explain Nernst distribution law. What are the limitations of the law?
33. What are fuel cells? Describe $H_2 – O_2$ fuel cell and its cell reactions.
34. Explain the terms (i) Fluorescence (ii) Phosphorescence
35. What are the laws of photochemistry , explain ?
36. Derive Clausius- Clapeyron equation and mention its applications .

Section D, Weight 4 each (long essay type)

(Answer any **two** questions.)

37. Discuss in detail Lindemann theory of unimolecular reactions.
38. (a) Derive van't Hoff equation for temperature dependence of equilibrium constant.

    (b) The equilibrium constant for a reaction is 1×10^5. Calculate the standard free energy change for the reaction in kilojoules at $25^?$ C .
39. How will you determine the transport number of ions by moving boundary method? **4×2 = 8**

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1671 -INDUSTRIAL CHEMISTRY-V

Vocational Course-9 Credit-4 Total 36 hrs Lecture-: 2 Hrs per week

Module 1 Processes in organic Chemical manufacture-I 6 hrs

Halogenation- introduction-Kinetics of halogenation, Reagents for halogenation-Halogenation of aromatics-side chain and nuclear halogenation. Manufacture of Chlorobenzene, Chloral, monochloroacetic acid, Chloromethane, Dichlorodifluoromethane.

Module 2 Process in Organic Chemical Manufacture - II 6 hrs

Sulphonation-sulphonating agents, chemical and physical factors in sulphonation, kinetics and mechanism of sulphonation, Commercial sulphonation of benzene naphalene, alkyl benzene.

Module 3 Processes in Organic Chemical manufacture-III 6hrs

Oxidation- Introduction-type of oxidation, oxidizing agents, kinetics and mechanism, Liquid phase oxidation, vapour phase oxidation, commercial manufacture of benzoic acid, maleic anhydride, phthaleic anhydride, acrolein, acetaldehyde, acetic acid

Module 4 Process in Organic Chemical Manufacture – IV 6 hrs

Hydrogenation- introduction-kinetics and thermodynamics- catalysts, hydrogenation of vegetable oils,manufacture of methanol from CO and H_2. Hydrogenation of acids and esters to alcohol, catalytic reforming

Module 5 Environment and air pollution - I (6hrs)

Environment, nature of environmental threats and the role of chemistry.

Chemistry of the air, water and soil environment. Factors affecting environment.

Types of environment. Structure and composition of atmosphere. Air as an ecological factor. Biosphere. Current environmental problems. Importance of clean air. Pollution, origin of pollution, Classification of pollutants – Global, Regional, Local, Persistent and

Module 6 Environment and Air Pollution – II 6 hrs

Non-persistent. Air pollutants – Oxides of carbon, sulphur, nitrogen, hydrocarbons, VOC and SPM. Persistent organic pollutants,

Chlorofluorocarbons, Dioxins, automobile exhaust. Alternate refrigerants. Health and environmental effects of pollutants

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1672 -INDUSTRIAL CHEMISTRY-VI

Vocational Course-10 Credit-4 Total 36 hrs Lecture-: 2 Hrs per week

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Module 1. Control and monitoring of air pollutants I 6hrs)

Air pollution control measures – Gravitational settling chamber, fabric filter,

wet scrubber, catalytic converters, stacks and chimneys, cyclone collectors, Cottrel electrostatic precipitator, extraction ventilator, zoning and green belt.

Module 2. Control and monitoring of air pollutants II (6hrs)

Air pollutant monitoring: Sampling methods for particulate analysis- filtration, sedimentation, electrostatic samplers, thermal precipitators and impingers. Sampling methods for gases and vapours – cold trapping, absorption and adsorption. Analytical methods for the determination of CO, NOx , SOx, H2S, Hydrocarbons and particulate matter.

Module 3 Water pollution - I (6hrs)

Importance of water, self purification capacity of the water body, visible signs of water pollution, sources of water pollution, fate of pollutants in aquatic systems, effects of water pollution. Eutrophication, Oil pollution

Module 4 Water pollution - II (6hrs)

Parameters which affect water quality and the associated problems. Water quality standards. Detection of fluoride, chloride, sulphate, nitrate, phosphate, acidity and alkalinity of water.

Biological magnification and bioaccumulation.

Module 5: Industrial waste water treatment (6hrs)

Method to control water pollution. Aerobic and anaerobic oxidation. Sedimentation, coagulation, filtration, disinfection, desalination and ion exchange. Primary treatment, secondary treatment - trickling filters, activated sludge process, sludge digestion. Tertiary treatment. USAB process and deep well injection. Sewage, sewage anlysis- total solids, settlable solids, suspended solids, dissolved oxygen, BOD (winklers titration method and dissolved oxygen metre) and COD.

Module 6 Other forms of pollution (6 hrs)

Soil pollution – control measures, Radioactive pollution- disposal methods, radiation protection terms. Noise pollution and noise control. Chemical pollution, Pesticide pollution, Thermal pollution – effects and control measures, Power generation pollution, Solid waste management – processing of solid waste, treatment and disposal methods. Non anthropogenic and anthropogenic impacts on environment.

References

1. De., Environmental Chemistry, 6th Edition, New Age International.
2. P.K.Goel, Water Pollution, Causes, Effects and Control, New Age International.
3. Kochu Baby Manjooran, Modern Engineering Chemistry (Kerala University), Kannatheri Publications.
4. Shashi Chowla, Engineering Chemistry, Dhanpat Rai Publishing Company.
5. P.C. Jain and Moniika Jain, Engineering Chemistry, Dhanpat Rai Publishing Company.

MODEL QUESTION PAPER

INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1671 -INDUSTRIAL CHEMISTRY-V

SEMESTER-VI

IC 1672- INDUSTRIAL CHEMISTRY- VI

ELECTIVES

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1651.1 - SUPRAMOLECULAR, NANO, AND GREEN CHEMISTRY

Elective Course 1 Credit-2 Total 54 hrs Lectures per week: 3

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_2 and H_2O, 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 laborataries- lab safety signs- introduction to micro scale experiments.

Module III Chemistry of Nano Materials Part I 9 Hrs

Evolution of Nanoscience – Historical aspects- Preparations containing nano gold in traditional medicine. Lycurgus cup- Faraday's divided metal

Nanosystems in nature.

Preparation of nanoparticles: Top-down approaches and Bottom to top approach

Sol–gel synthesis, Colloidal precipitation, Co–precipitation, Combustion technique, Sono chemistry, Hydrothermal technique, High energy ball milling

Synthesis of nanometre scale particles of colloidal semiconductors such as TiO_2, CdS, ZnO, $BaTiO_3$, by wet chemical methods, hydrothermal methods, and pyrolytic or high temperature methods.

Carbon nanotubes and fullerenes. Synthesis and purification of carbon nanotubes, Single-walled 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

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1651.2 - COMPUTATIONAL, COMBINATORIAL AND PHYSICAL ORGANIC CHEMISTRY

Elective Course 2 Credit-2 Total 54 hrs Lectures per week: 3

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_2O, CO_2& NH_3.

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 sold 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 on 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 – Substituion, 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 – ?H, ?S and ?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 hours

The effect of substrate structure – Differences in mechanism for primary, secondary and tertiary systems. The effect of a and ß substitution – the +I and –I effects (Inductive effects of electron releasing and electron withdrawing groups at a and ß

positions). Substitution of mono and bicyclic (at a and ß positions) aromatic rings (Resonance effects). Hyperconjugate effects. Neighbouring group effect nonclassical bridge head - Steric effects – B-strain, Strain in aliphatic cyclic systems. Sterric inhibition of resonance – ortho effect and a-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 Jenson,"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, Wiely International (Indian edn New Delhi) Chapter 6 and 10
8. P S Kalsi," Text of organic Chemistry", Mac million India ltd 1999 Ch 2
9. M K Jain and S C Sharma," Modern Organic Chemistry" , Vishal Publishing Co, 2004, Chapter 3,4, 15

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1651.3 - POLYMER CHEMISTRY

Elective Course 3 Credit-2 Total 54 hrs Lectures per week: 3

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

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1651.4 – BIOHEMISTRY

Elective Course 4 Credit-2 Total 54 hrs Lectures per week: 3

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_2 and CO_2 during respiration, Transport of Oxygen in Blood O_2 dissociation curve, Interrelationship between O_2 and CO_2 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.

REFERENCE

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"

MODEL QUESTION PAPER

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1651.1 - SUPRAMOLECULAR, NANO, AND GREEN CHEMISTRY

Time : Three Hours **Total Weight : 30**

Section A, Weight 1 each (answer in a word \ sentence)

Answer all questions

I 1. Union carbide factory in Bhopal was involved in the manufacture of _____.

2. _____is an example of supercritical fluid.

3. _____is a safer chemical.

4. Size of nano gold particle will be between _____ to _____nm.

II. 5. Write an advantage of super critical fluid.

6. Write an example of a green catalyst.

7. Lycurgus cup contains _____ nano particle.

8. Name a colloidal semi conductor.

III. 9. SEM stands for _____.

10. AFM uses _____ to scan the surface of a material.

11. The STM is based on_____ of electrons.

12. Carcerand are designed to contain _____.

IV. 13. A photosensitive molecular receptor contains _____ as a photosensitive functional group.

14. Cation carriers generally contains_____ charged functional groups.

15. Who proposed the correct structure of DNA ?

16. Between an addition and elimination reaction _____ has a better atom economy. **1×4 = 4**

Section B, Weight 1 each (short answer type)

Answer any eight questions from the following. The answer must contain 4 points.

17. Which factor lead to the development of green chemistry ?
18. Write a note on Bhopal gas tragedy .
19. Comment on the greenness of liquid bromine as a reagent.
20. Explain co-precipitation.
21. What is hydrothermal methods of preparing colloidal semiconductors.
22. What are the magnetic properties of nanoparticles.
23. What is ? -stacking ?
24. Explain the basis of green chemistry.
25. What are the non-covalent bonds involved in molecular recognition?
26. Explain high energy ball milling.
27. What are quantum dots ?
28. How are multi walled carbon nano tubes synthesized? **1×8 = 8**

Section C, Weight 2 each (short essay type)

Write any five from the follwing. T he answer must contain 8 points.

29. Write a note on safer solvents and auxiliaries.
30. Explain ionic liquids.
31. What is the principle of microwave oven'
32. How can atom economy be calculated?
33. Explain sono chemistry.
34. Write a note on applications of nano particles.
35. What are cyclophanes and calix arenes ?
36. Discuss cation and anion receptors. **2×5 = 10**

Section D, Weight 4 each (long essay type)

Write any two

37. Explain the terms, Ionic Bonding, H- bonding, van der Waal and hydrophobic interactions.
38. Explain the principles of green chemistry.
39. Discuss the various aspects of molecular recognition involved in the structure of DNA and proteins. **4×2 = 8**

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1651.2 - COMPUTATIONAL, COMBINATORIAL AND PHYSICAL ORGANIC CHEMISTRY

Time : Three Hours **Total Weight : 30**

Section A, Weight 1 each (answer in a word\sentence)

Answer all questions

I. 1. DFT stands for _____.
2. RHF is the abbreviation of _____.
3. Modified version of RHF is _____.
4. The expansion of UHF is _____

II. 5. Who first proposed solid phase peptide synthesis ?
6. _____ is an example of electrophilic reagent.
7. The relation connecting ?H,?S and ?G ?
8. Propene is more stable than ethane due to_____ .

III. 9. _____ synthesis is an example of solution phase library synthesis.
10. Combinatorial synthesis is based on_____ and _____ synthesis.
11. _____ is an example of heterolytic bond breaking reaction.
12. Arrhenius expression is _____ .

IV. 13. Write Hammett equation.
14. An example of polyamide resin.
15. An example of nucleophilic reagent is ____ .
16. All pericyclic reactions involve a _____ intermediate. **1×4= 4**

SectionB, Weight 1 each (short answer type)

Answer any eight questions from the following. The answer must contain 4 points.

17. What are the web resources in learning Chemistry?
18. What is a basis set ?
19. What are the major mechanisms of organic reactions ?
20. Distinguish between STO & GTO.
21. Explain the advantages of combinatorial synthesis.
22. Write an example of an electrocyclic reaction..
23. What are the applications of combinatorial synthesis.
24. What are multipins used in combinatorial synthesis

25. Explain kinetic requirements of reaction .
26. Explain Hammond postulate.
27. Explain +I and – I effects.
28. Explain isotopic labeling in the study of organic reactions. **1×8 = 8**

Section C, Weight 2 each (short essay type)

Answer any five questions from the following. The answer must contain 8 points.

29. Explain Z matrix of H_2O & NH_3
30. How are molecular visualization softwares used in learning chemistry..
31. How can a eight – member dipeptide library is synthesized ?
32. Explain non-peptide libraries.
33. How are the intermediates detected?
34. Explain substitution reactions of naphthalene.
35. Explain the effect of leaving group in aliphatic substitution reactions.
36. What is self consistent field method. **2×5 = 10**

Section D, Weight 4 each (Long essay type)

Answer any two questions

37. Explain MO theory of hydrogen molecule ion and VB theory of hydrogen
38. Explain neighbouring group participation with examples.
39. How does the structure of substrate affect the aliphatic nucleophilic substitution

MODEL QUESTION PAPER

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

IC 1651.3 - POLYMER CHEMISTRY

Time : Three Hours **Total Weight : 30**

Section A (Weight 1 each)(Answer in one word\sentence)

Answer all questions

I 1. Name of one natural polymer.
2. Name of one condensation polymer.
3. Name of one inhibitor of chain reaction.
4. Name one addition polymer.

II 5. Bakelite is a polymer of formaldehyde and _____.
6. Silicones have the linkage of _____.
7. One amino resin is _____.
8. HDPF is _____.

III 9. What is SBR.

10. What is the structure of the monomer of polyvinyl acetate.
11. What are the monomers of nylon .
12. What is the monomer o neoprene.

IV. 13. One polymer industry in India is at_____.
14. LLDP is _____.
15. SAN is _____.
16. Teflon is _____. **1×4 = 4**

Section B (Weight 1 each) (short answer type)

Answer any eight from the following. The answer must contain 4 points.

17. What are the different types of polymers?
18. Explain the different types of polymerization.
19. What is polyvinylacetate ?
20. Distinguish between graft and copolymers.
21. How is melamine-formaldehyde resin prepared?
22. What are elastomers?
23. Write a note on poly olephine.
24. Compare nylon 6 with nylon 6,6.
25. What is the practical significance of molecular weight distribution?
26. Explain fibre spinning.
27. Explain extrution.
28. What is Carother's reaction? **1×8 = 8**

Section C (Weight 2 each) (Short essay type}

Answer any five from the following. The answer must contain 8 points.

29. Explain number , weight and viscosity average molecular weight.
30. Explain kinetics of polymerization.
31. Explain the preparation of PVC.
32. xplain synthesis and applications of polyurethanes.
33. What are epoxy resins?
34. Explain the size of polymers.
35. What are the factors affecting GTT.
36. Explain polymer processing. **2×5 = 10**

Section D (Weight 4 each) (essay type)

Answer any two

37. What are the methods of determining molar mass?
38. Write notes on (1) compression (2) moulding(3) casting
39. (a) Explain crystallinity in polymers (b) Explain thermal, elevtrical and mechanical properties of polymers. **4×2 = 8**

MODEL QUESTION PAPER

CHEMISTRY AND INDUSTRIAL CHEMISTRY PROGRAMME

SEMESTER – VI

BIOCHEMISTRY IC 1651.4

Time : 3 Hours **Total Weight : 30**

Section A (Weight 1 each) (answer in a word\sentence)

Answer all questions

I 1. _____ is called good cholesterol.
2. _____ is the cause of sickle cell aneamia .
3. An example of plasma protein is _____.
4. An example of a lipo protein is _____.

II 5. Among the blood cells which is the largest blood cell.
6. NPN stands for _____.
7. Write the renal threshold value of glucose.
8. How much calories are obtained from 1 g of fat?

III. 9. Write the oxidation state of iron in haemoglobin.
10. Name one bile pigment.
11. Technique used to separate bio molecules according to the size.
12. Expand GLC.

IV. 13. Normal pH of blood is_____.
14. Haemoglobin combines with CO_2 to form_____.
15. Name of the primary bile acid is _____.
16. Enzyme present in gastric juice is _____ **1×4 = 4**

Section B (Weighta1 each) (short answer type)

Answer any eight from the following. The answer must contain 4 points.

17. What is the difference between plasma and serum?
18. What is pulmonary respiration?
19. What are the constituents of plasma?
20. What is adsorption chromatography?
21. Write short notes on carbohydrates splitting enzymes.
22. Define BMR.
23. Define Rf value.
24. Comment on adult haemoglobin and foetal haemoglobin..
25. Draw the structure of haemo group.
26. What are the abnormal constituents of urine?
27. Write the functions of plasma protein.
28. Write a note on abnormal haemoglobin. **1×8 = 8**

Section C (Weight 2 each) (Short essay type)

Answer any five from the following. The answer must contain 8 points.

29. Explain O_2 dissociation curve.
30. Explain the interrelationship between O_2 and CO_2 transport.
31. Explain SDS PAGE.
32. Define briefly blood cells.

33. Comment on major blood buffers.
34. Write the composition and function of bile.
35. Explain paper chromatography.
36. Briefly describe ion exchange chromatography. **2×5 = 10**

Section D (Weight 4 each) (essay type)

Answer any two

37. Explain the digestion and absorption of fat.
38. What are the functions of kidney? Explain urine formation in detail.
39. What are coagulation factors? Explain the mechanism of coagulation?

4×2 = 8

CHEMISTRY LABORATORY COURSES

CHEMISTRY AND **Industrial Chemistry -Programme Chemistry Lab Courses**

SEMSTER 1, 2 Course Code IC1142 & IC1242 (Lab Course Number 1 and 2)
Three hours examination in semester II . (Credit 4)

I. Qualitative Analysis

a. Studies of the reactions of the following radicals with a view to their identification and confirmation: Pb^{2+}, Cu^{2+}, Bi^{3+},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 semimicro 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. Hexammine cobalt Chloride
c. Tetrammine copper Sulphate
d. Mohr's salt
e. Microcosmic salt
f. Sodium cobalti nitrate
g. Sodium nitro prusside
h. Manganese phthalocyanin
i. Potassium trioxalatochromate and
j. Potassium trioxalatoferrate
k.

SEMSTER III and IV, 4 Course Code IC1343 & IC1443
(Chemistry Lab Course Number 3 and 4)
Three hours examination in semester IV (Credit 3) IC 1443

1.Volumetry

(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 ofNa_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 standardised permanganate solution (1) Ferrous iron (2) Oxalic acid (3)Mohr's salt (4) Hydrogen peroxide (5) Calcium (6) Nitrte and (7) MnO_2 in pyrolusite.

(c) Dichrometry

Determination of Ferrous iron using internal and external indicators and Ferric iron after reduction with $SnCl_2$

(d) Cerimetry

Standardisation of ceric ammonium sulphate with Mohr's salt. Determination of oxalic acid using ceric ammonium sulphate.

(e) Iodometry\Iodimetry

Standardisation of thiosulphate using 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 $ZnSO_4$ – determination of Zn, Mg, Ni and Ca – determination of permanent and temporary hardness of water.

(h). Colorimetry (Using photo electric colorimeter)

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

II. Physical Chemistry Practicals

The following experiments are to be done :

Determination of

1. Partition coefficient of iodine between CCl_4 and H_2O
2. Transition temperature of a salt hydrate. Molar mass of a solute using transition point depression of a salt hydrate.
3. Molar mass of a solute. Depression in freezing point of a solid solvent by cooling curve method.
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 index of KCl solutions of different concentrations and then concentration of an unknown solution.
8. Conductometric titration of NaOH Vs HCl.
9. Potentiometric titration of Fe^{2+} vs $Cr_2O_7^{2-}$
10. Potentiometric titration of $KMnO_4$ 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

SEMSTER V and VI, Course Code IC1542 & IC1642
(Chemistry Lab Course Number 5 and 6)
Three hours examination (ESE) in semester VI (Credit 2) IC1642

1. Gravimetry

The following determinations are to be done using silica crucible (1) Ba as $BaSO_4$ (2) Sulphate as $BaSO_4$ (3) Iron as Fe_2O_3 (4) Calcium as $CaCO_3$ (5) Aluminium as Al_2O_3 and Magnesium as $Mg_2P_2O_7$.

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

II. Organic Chemistry Practicals

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.

III.Chromatography

a. Paper chromatographic separation of mixture of nitroanilines, amino acids and sugars.
b. Separation of a mixture of dyes by column chromatography.

IV.Organic estimation

c. Molar mass determination of an acid and base by titration method

d. Determination of the phenol/aniline by bromate – bromide mixture.

REFERENCE

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

SEMSTER III and IV, Course Code IC1372 & IC1472

(Industrial Chemistry Lab Course Number 1 and 2)

Three hours examination in semester IV . (Credit 4) IC 1472

1. Preparation of organic compounds: Single stage preparations by reactions involving nitration, halogenation, oxidation, reduction, alkylation, acylation, condensation and rearrangement. (A student is expected to prepare at least 10 different organic compounds by making use of the reactions given above).
2. General methods of separation and purification of organic compounds with special reference to:
   (a) Solvent extraction
   (b) Fractional crystallization.
   (c) Steam distillation and distillation under reduced pressure
3. Thin layer chromatography and identification of simple organic compounds
4. Determination of saponification value, iodine value and acid value of oils
5. Estimation of nitrogen in fertilizers by Kjeldhals method

References

1. A.I.Vogel, "A Textbook of Practical Organic Chemistry", Longman
2. A.I.Vogel, "Elementary Practical Organic Chemistry – Part 3: Quantitative Organic Analysis", Longman
3. F.G.Mann and B.C.Saunders, "Practical Organic Chemistry", Longman
4. B.B.Dey and M.V.Sitaraman, "Laboratory Manual of Organic Chemistry"

SEMSTER V Course Code IC1573
(Industrial Chemistry Lab Course Number III)
Three hours examination in semester V (Credit 4)

A. Volumetric analysis

1. Determination of acetic acid content in Vinegar by titration with NaOH.
2. Determination of alkali content in antacid tables by titration with HCl.
3. Determination of copper content is basis by Iodometric titration.
4. Determination of available chlorine in bleaching powder.
5. Determination of COD of water samples
6. Determination of hardness of water
7. Determination of Mn content in Pyrolusite

SEMSTER VI Course Code IC1673
(Industrial Chemistry Lab Course Number IV)
Three hours examination in semester VI (Credit 4)

B. Colorimetric analysis

1. Colorimetric estimation of Iron
2. Colorimetric estimation of Chromium
3. Colorimetric estimation of Glucose
4. Determination of dissociation constant of acetic acid using pH meter.
5. Determination of strength of hydrochloric acid solution(approximately N\10) by titrating it against sodium hydroxide solution conductometrically.
6. Estimation of nickel in the given sample using DMG.
7. Determination of the rate constant of the hydrolysis of ethyl acetate using an alkali at room temperature.
8. Separation of dyes by thin layer chromatography.
9. Preparation of urea-formaldehyde resin and nylon-6 6.
10. Preparation of benzene azo ß-naphthol.
11. Preparation of ?-bromo acetanilide from acetanilide.

FIRST DEGREE PROGRAMME IN CHEMISTRY AND

INDUTRIAL CHEMISTRY

COURSE : CHEM LAB I

This laboratory based course reinforces the qualitative chemical analysis that the student

has learned in the theory

COURSE OFFERING AND CREDITS

Semester II ; credits: 4

COURSE OBJECTIVES

To equip the students with skill in qualitative chemical analysis of inorganic materials.

After the course completion, the student will have the necessary training required for laboratory based wet chemical analysis.

COURSE TRANSACTION FORMAT

Lecture-Tutorial-Lab: 0-0-2 hours per week; eighteen 5-day weeks per semester.

Contact hours per semester: 36 hrs lab instruction.

MODE OF EVALUATION

Continuous Evaluation: The Continuous evaluation will have 25% percentage weight. Grades A-E will be awarded for each component. There will be two quizzes / tests for which, the average of the two grades obtained will form part of CE. The CE components are: (i) Attendance for laboratory sessions (ii) Experiment (Lab) Report on completion of each set of experiments (iii) Laboratory Skill and (iv) Quiz / Test. These are summarized below. Total Weight is 4.

Components of CE For Lab Courses			
No	*Component*	*Weight*	*Grades*
1	Attendance	1	≥90% - A <90 - ≥85% - B <85 - ≥80% - C <80 - ≥75% - D <75% - E
2	Experiment (Lab) Report	1	A-E
3	Laboratory Skill	1	A-E
4	Quiz / Test	1	A-E

Evaluation of the Experiment (Lab) report and Lab Skill: On completion of each experiment, an "experiment (lab) 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, tables of data collected, equations, calculations, graphs, 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.

Mode of Experiment (Lab) Report Evaluation		
No	*Main Component*	*Grades*
1	Punctual submission and Neat presentation	All four sub-components : A Only three : B Only two : C Only one : D None : E
2	Inclusion of aim, materials, procedure etc.	
3	Calculations and absence of errors/mistakes	
4	Accuracy of the result	

Mode of Lab Skill Evaluation		
No	*Main Component*	*Grades*
1	Punctuality and experiment completion on time	All four sub-components : A Only three : B Only two : C Only one : D None : E
2	Lab skill & Neat arrangements of table and apparatus in lab	
3	Prompt and neat recording of observations in lab note book.	
4	Experimental Skill and attention to safety	

Details of the Lab Quiz / Test: The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, grades A-E may be awarded and the average grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

End Semester Evaluation: 75% percentage weight. Total Weight is 30. The ESE of the qualitative experiment(analysis of the mixture of two salts- containing two anions and two cations) of Course Chem Lab-I and II will be on the 2nd semester. The Examination will be of 3- hr duration. .End semester University laboratory examinations of Courses Chem Lab-IIIand IV (Volumetry and Physical Chemistry) and Chem Lab V and VI (Gravimetry and Organic Chemistry) will be of 6-hr duration.

The main components of the ESE for the Course Chem Lab will be (i) Principle and Procedure, (ii) Experiment Report & Lab Skill, (iii) Calculations & Result and (iv) Lab Course Record and each of these components should be assessed as part of the ESE of lab courses based on the sub-components as given below.

Main Components of ESE For Lab Courses			
No	*Main Components in General*	*Weight*	*Grades*
1	Principle and Procedure	4	A-E
2	Experiment Report & Lab Skill	8	A-E
3	Calculations & Result	12	A-E
4	Lab Course Record	6	A-E

If necessary this Table may be modified by the Board of Examiners.

The subdivisions in the case of (i) Inorganic Qualitative Analysis and (ii) Quantitative Volumetric Analysis(iii) Gravimetric analysis(iv)Organic experiments are given below.

Inorganic Qualitative Analysis Semester IV Course Code CH1442 Credit 2 = 2

Analysis of a mixture of two salts – two anions and two cations.

Examination in 4^{th} semester with 3- hrs duration. Total weight for ESE is 30 and for CE is 4.

Sub-Components for End Sem Evaluation of Inorganic Qualitative Analysis				
No	*Main Component*	*Weight*	*Sub-Components*	*Grades*
1	Principle and Procedure	4	i. Principle of the experiment stated ii. Aim of the experiment stated iii. Separation Scheme stated iv. Materials & apparatus specified.	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
2	Experiment Report &Lab Skill	8	i. Preliminary experiments done ii. Preliminary reports correct iii Satisfactory skill in experimentation iv. Neatness of data and result presentation	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
3	Calculations & Result	12	i. 4 ions correctly identified ii. 3 ions correctly identified iii.2 ions correctly identified iv.1 ion correctly identified v. 0 ion correctly identified	A B C D E
4	Lab Course Record Book	6	i. Required No: of Experiments done ii. Data and experimental details sufficient iii. Correctness of results reported iv. Neatness of presentation and absence of errors/mistakes in the Record Book	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E

If necessary this Table may be modified by the Board of Examiners.

Semester IV Course Code IC1242 , Chemistry Practical Course Number 2

Inorganic Quantitative Analysis(Volumetric Analysis) and Physical Chemistry Experiments, Credit 4 . Chem Lab III and IV

Examination – 6 hrs duration , Estimation of ion or salt in Volumetric Analysis and any one Physical Chemistry Experiment . Total weight for ESE is 30 and for CE is 10. The Table for Physical can be modified according to the nature of the experiment by the Board of Examiners.

Sub-Components for End Sem Evaluation of Quantitative Volumetric Analysis				
No	*Main Component*	*Weight*	*Sub-Components*	*Grades*
1	Principle and Procedure	2	i. Principle of the experiment stated & correct ii. Aim of the experiment stated & correct iii. Procedure stated & correct iv. Materials & apparatus specified	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
2	Experiment Report &Lab Skill	4	i. Standardization Calculation correct ii. Estimation Calculation correct iii Unknown Weight Calculation iv. Neatness of data and result presentation	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
3	Calculations & Result	6	i. $\leq$1% ii. >1- $\leq$ 1.4 iii.> 1.4 - $\leq$ 1.8 iv.> 1.8 - $\leq$ 2.2 v. > 2.2	A B C D E
4	Lab Course Record Book	3	i. Required No: of Experiments done ii. Data and experimental details sufficient iii. Correctness of results reported iv. Neatness of presentation and absence of errors/mistakes in the Record Book	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E

If necessary this Table may be modified by the Board of Examiners.

CE for half(lab) courses like volumetry, gravimetry, physical and organic experiments

Components of CE For Lab Courses			
No	*Component*	*Weightage*	*Grades*
1	Attendance	1	≥90% - A <90 - ≥85% - B <85 - ≥80% - C <80 - ≥75% - D <75% - E
2	Experiment (Lab) Report	1	A-E
3	Laboratory Skill	1	A-E
4	Quiz / Test	1	A-E

If necessary this Table may be modified by the Board of Examiners.

Sub-Components for End Sem Evaluation of Physical Chemistry Experiments				
No	*Main Component*	*Weight*	*Sub-Components*	*Grades*
1	Principle and Procedure	2	i. Principle of the experiment stated & correct ii. Aim of the experiment stated & correct iii. Procedure stated & correct iv. Materials & apparatus specified	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
2	Experiment Report &Lab Skill	4	i. Correct Representation of Data ii. Graphical Representation iii Satisfactory skill in experimentation iv. Neatness of data and result presentation	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
3	Calculations & Result	6	i. $\leq$1% ii. >1- $\leq$ 1.4 iii.> 1.4 - $\leq$ 1.8 iv.> 1.8 - $\leq$ 2.2 v. > 2.2	A B C D E
4	Lab Course Record Book	3	i. Required No: of Experiments done ii. Data and experimental details sufficient iii. Correctness of results reported iv. Neatness of presentation and absence of errors/mistakes in the Record Book	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E

If necessary this Table may be modified by the Board of Examiners.

Semester VI Course Code IC 1642 Practical Course Number V and VI

Chem Lab 5 and 6

Inorganic Quantitative Analysis(Gravimetric Analysis) and Organic Chemistry Experiments. Credit 4

Any one estimation in gravimetric analysis and in organic experiments, analysis of a compound, one organic compound preparation and determination of physical constant of any organic compound are included. Total weight for ESE is 30 and for CE it is 4.

Sub-Components for End Sem Evaluation of Quantitative Gravimetri cAnalysis				
No	*Main Component*	*Weight*	*Sub-Components*	*Grades*
1	Principle and Procedure	2	i. Principle of the experiment stated & correct ii. Aim of the experiment stated & correct iii. Procedure stated & correct iv. Materials & apparatus specified	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
2	Experiment Report &Lab Skill	4	i. Correct Equation and Result Representation ii. Correct Calculation iii Satisfactory skill in experimentation iv. Neatness of data and result presentation	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
3	Calculations & Result	6	i. ≤1% ii. >1- ≤ 1.4 iii.> 1.4 - ≤ 1.8 iv.> 1.8 - ≤ 2.2 v. > 2.2	A B C D E
4	Lab Course Record Book	3	i. Required No: of Experiments done ii. Data and experimental details sufficient iii. Correctness of results reported iv. Neatness of presentation and absence of errors/mistakes in the Record Book	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E

If necessary this Table may be modified by the Board of Examiners.

Sub-Components for End Sem Evaluation of Organic Chemistry Experiments				
No	*Main Component*	*Weight*	*Sub-Components*	*Grades*
1	Principle and Procedure	2	i. Procedure of preparation- method Ii .Procedure of preparation - equation iii. Detection of elements in O C iv. O C –Aromatic or Aliphatic	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
2	Experiment Report &Lab Skill	4	i. Quality of the Recrystallised Compound Prepared ii. Quantity of the Compound Prepared iii Physical Constants - + or - 2 iv. Preparation of derivative	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
3	Calculations & Result	6	3 correct test 2 correct test 1 correct test O C – Saturated or unsaturated Incorrect	A B C D E
4	Lab Course Record Book	3	i. Required No: of Experiments done ii. Data and experimental details sufficient iii. Correctness of results reported iv. Neatness of presentation and absence of errors/mistakes in the Record Book	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E

If necessary this table may be modified by the Board of Examiners.

PROJECT– Factory Internship

Students have to undergo a training at a chemical factory of their choice and submit a report of the raw materials, processes and end products and their analysis. The lecture hours of V and VI semesters are adjusted for the students to do continuous work in a factory.

EVALUATION OF THE PROJECT

The project details should be submitted typed/written on A4 size paper should be 25-40 pages.. The project report will first be evaluated by awarding grades A-E based for each of the four components below in Table .

Mode of Project Evaluation		
No	*Main Component*	*Grades*
1	Adherence to overall structure & submission deadline	All four main components present & satisfactory : A Only three : B Only two : C Only one : D None : E
2	Content & grasp of the topic	
3	Lucidity / Clarity of presentation	
4	References/Overall effort	

The following explanatory guidelines are suggested tentatively for the assessment of each of the above main components as satisfactory or not.

Sub-Components for End Sem Evaluation of Physical Chemistry Experiments				
No	*Main Component*	*Weight*	*Sub-Components*	*Grades*
1	Principle and Procedure	2	i. Principle of the experiment stated & correct ii. Aim of the experiment stated & correct iii. Procedure stated & correct iv. Materials & apparatus specified	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
2	Experiment Report &Lab Skill	4	i. Correct Representation of Data ii. Graphical Representation iii Satisfactory skill in experimentation iv. Neatness of data and result presentation	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E
3	Calculations & Result	6	i. $\leq$1% ii. >1- $\leq$ 1.4 iii.> 1.4 - $\leq$ 1.8 iv.> 1.8 - $\leq$ 2.2 v. > 2.2	A B C D E
4	Lab Course Record Book	3	i. Required No: of Experiments done ii. Data and experimental details sufficient iii. Correctness of results reported iv. Neatness of presentation and absence of errors/mistakes in the Record Book	All 4 subcomponents : A Only three : B Only two : C Only one : D None : E

University of Kerala
SEMESTER I: Auxiliary Course in Mathematics for Chemistry and Industrial Chemistry
Mathematics-I
(Complex numbers, Differentiation and Matrices)
Code: MM 1131.7 Instructional hours per week: 5
No. of Credits: 4

Overview of the course:

The auxiliary course intended for students of Chemistry and industrial Chemistry lays emphasis on the application of mathematical methods. The first module gives an introduction to complex numbers. The next two modules on Calculus links the topic to the real world and the student's own experience as the authors of the text put it. Doing as many of the indicated exercises from the text should prove valuable in understanding the applications of the theory. Applications of the subject on the lines of those in Physics as given in the text could be obtained from the net. The fourth module covers theory of equations.

Module 1: Complex Numbers

• Review of basic results: Introduction to complex numbers, representation of complex numbers, the Argand diagram, De Moivre's theorem, evaluation of roots of complex numbers, finding n^{th} roots of unity, its properties,
• expansion of trigonometric functions of multiples of angles, expansion of powers of trigonometric functions, separation into real and imaginary parts

Module 2: Differentiation with applications I

• Functions and graphs of functions with examples . Interpretations of slope. The graph showing direct and inverse proportional variation. Mathematical models (functions as models). Parametric equations. Cycloid.
Exercise set 1.8; Questions 31 - 34.
• Instantaneous velocity and the slope of a curve. Limits. Infinite limits and vertical asymptotes. Limits at infinity and horizontal asymptotes. Some basic limits. Indeterminate forms of the type 0/0.
Exercise set 2.1; Questions 27 and 28.
• Continuity. Slopes and rates of change. Rates of change in applications. Derivative.
Exercise set 3.1; Questions 1, 2 and 16.
• Techniques of differentiation. Higher derivatives. Implicit differentiation. Related rates. Local linear approximation. Differentials. Examples 1 - 6.
Exercise set 3.8; Questions 53 - 55.
• Rectilinear motion. Speeding up and slowing down. Analysing the position versus time curve. Free fall motion.
Examples 1 - 7. Exercise set 4.4; Questions 8, 9, 30 - 32.
• Absolute maxima and minima. Applied maximum and minimum problems.

Exercise set 4.6; Questions 47 and 48.
• Statement of Rolle's Theorem and Mean Value Theorem. The velocity interpretation of Mean Value Theorem. Statement of theorems 4.1.2 and 4.83 (consequences of the Mean Value Theorem).
• Inverse functions. Continuity and differentiability of inverse functions. Graphing inverse functions. exponential and logarithmic functions. Derivatives of logarithmic functions and logarithmic differentiation. Derivatives of the exponential function. Graphs and applications involving logarithmic and exponential functions.
Exercise set 7.4; Question 50.
• L'Hospital's Rule for finding the limits (without proof) of indeterminate forms of the type 0/0 and 1/1. Analysing the growth of exponential functions using L'Hospital's Rule. Indeterminate forms of type 0 ·1 and 1- 1 and their evaluation by converting them to 0/0 or 1/1 types. Indeterminate forms of type 0_0, 1_0 and 1_1.
• Definitions of hyperbolic functions. Graphs of hyperbolic functions. Hyperbolic identities. Why they are called hyperbolic functions. Derivatives of hyperbolic functions. Inverse hyperbolic functions. Logarithmic forms of inverse hyperbolic functions. Derivatives of inverse hyperbolic functions.

Module 3: Differentiation with applications II

• Power series and their convergence. Results about the region of convergence of a power series(without proof). Radius of convergence.
Functions defined by a power series. Results about term by term differentiation and integration of power series (without proof). Taylor's theorem with derivative form of remainder (without proof) and its use in approximating functions by polynomials. Taylor series and Maclaurin's series and representation of functions by Taylor series. Taylor series of basic functions and the regions where these series converge to the respective functions. Binomial series as a Taylor series and its convergence. Obtaining Taylor series representation of other functions by differentiation, integration, substitution etc.
• Functions of two variables. Graphs of functions of two variables. Equations of surfaces such as sphere, cylinder, cone, paraboloid, ellipsoid, hyperboloid etc. Partial derivatives and chain rule (various forms). Euler's theorem for homogeneous functions. Jacobians.
Exercise set 14.3; Questions 47 and 48.
Exercise set 14.4; Question 50.
Exercise set 14.5; Question 42.
• Local maxima and minima of functions of two variables. Use of partial derivatives in locating local maxima and minima. Lagrange method for finding maximum/minimum values of functions subject to one constraint.
Exercise set 14.9; Question 20.

Module 4: Theory of Matrices

• (Review only) basic concepts about matrices. Operations involving matrices, different types of matrices. Representation of a system of linear equation in matrix form. Inverse of a matrix, Cramer's rule.

• The rows and columns of a matrix as elements of R_n for suitable n. Rank of a matrix as the maximum number of linearly independent rows/columns. Elementary row operations. Invariance of rank under elementary row operations. The echelon form and its uniqueness. Finding the rank of a matrix by reducing to echelon form.
• Homogeneous and non-homogeneous system of linear equations. Results about the existence and nature of solution of a system of equations in terms of the ranks of the matrices involved.
• The eigen value problem. Method of finding the eigen values and eigen vectors of a matrix. Basic properties of eigen values and eigen vectors. Eigen values and eigen vectors of a symmetric matrix.
• Diagonalisable matrices. Advantages of diagonalisable matrices in computing matrix powers and solving system of equations. The result that a square matrix of order n is diagonalisabe (i) if and only if it has n linearly independent eigen vectors (ii) if it has n distinct eigen values. Method of diagonalising a matrix. Diagonalisation of real symmetric matrices. Similar matrices.

Module 1: 18 hours; Module 2: 24 hours
Module 3: 24 hours; Module 4: 24 hours

Text for Module 2 and 3 Howard Anton et al., Calculus. Seventh Edition, John Wiley & Sons inc
Text for Module 4: David C. Lay, Linear Algebra, Thompson Publications, 2007.

References:

1. James Stewart, Essential Calculus, Thompson Publications, 2007.
2. Thomas and Finney, Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley.
3. Peter V. O' Neil, Advanced Engineering Mathematics, Thompson Publications, 2007

SEMESTER II: Auxiliary Course in Mathematics for Chemistry and Industrial Chemistry

Code: MM 1231.7 Instructional hours per week: 5
No. of Credits: 4

Mathematics-II
(Analytic Geometry, Integration, Differential Equations and Theory of Equations)

Overview of the course:

The complementary course in the second semester continues in laying emphasis on applications of integral calculus and differential equations to problems in Chemistry.

Module 1: Analytic Geometry

• Geometric definition of a conic-the focus, directrix and eccentricity of a conic. Classification of conics into ellipse, parabola and hyperbola

based on the value of eccentricity. Sketch of the graphs of conics. Reflection properties of conic sections.
Exercise set 11.4; Questions 39 - 43.

• Equations of the conics in standard positions. Equations of the conics which are translated from standard positions vertically or horizontally. Parametric representation of conics in standard form. Condition for a given straight line to be a tangent to a conic. Equation of the tangent and normal to a conic at a point.

• Asymptotes of a hyperbola. Equation of the asymptotes. Rectangular hyperbola and its parametric representation. Equation of tangent and normal to a rectangular hyperbola at a given point.

• Rotation of co-ordinate axes. Equation connecting the co-ordinates in the original and rotated axes. Elimination of the cross product term in a general second degree equation by suitable rotation. Identifying conics in non-standard positions represented by general second degree equation by suitable rotation of axes. The discrimant of a general second degree equation and its invariance under rotation of co-ordinate axes. The conditions on the discriminant for the general second degree equation to represent a conic, a pair of straight lines or a circle.

Module 2: Integration with applications

• Indefinite integrals (Review only), integral curves, integration from the view point of differential equations, direction fields
Exercise set 5.2; Questions 43 and 44

• (Review only) Definite integral and Fundamental Theorem of Calculus.

• Rectilinear motion: finding position and velocity by integration. Uniformly accelerated motion. The free-fall model. integrating rates of change. Displacement in rectilinear motion. Distance travelled in rectilinear motion. Analysing the velocity versus time curve. Average value of a continuous function. Average velocity revisited.
Exercise set 5.7; Questions 3, 4, 5, 6, 29 and 55

• Review of integration techniques.

• Use of definite integrals in finding area under curves, area between two curves, volume of revolution, arc length and surface area of a solid of revolution.

• The idea of approximating the volume under a bounded surface in 3-space by volumes of boxes, leading to the definition of double integrals of functions of two variables over bounded regions. Evaluation of double integrals by iterated integrals. Evaluation by changing to polar co-ordinates and by suitably changing order of integration in the iterated integral. Applications to finding the volume of solids under bounded surfaces.

Module 3: Differential Equations

• Review of basic concepts about differential equations and their solutions. Method of solving special types of first order ODEs such as variable separable, exact, homogeneous, and linear. Finding the family of curves orthogonal to a given family.

• Second order linear differential equations. Nature of the general solution

of homogeneous and non-homogeneous linear ODEs. Extension to higher order ODEs.

• Second order linear homogeneous ODEs with constant coefficients. The characteristic equation and its use in finding the general solution. Extension of the results to higher order ODEs.

• Second order linear non-homogeneous ODEs with constant coefficients. General solution as the sum of complementary function and particular integral. Second order linear differential operator and its properties. The inverse operator and its properties. Operator method for finding the particular integral of simple functions. Extension of the results to higher order equations. Cauchy and Legendre equations and their solutions by reducing to equations with constant coefficients by suitable change of variable.

Module 4: Theory of equations

• Polynomial equations and fundamental theorem of algebra (without proof). Applications of the fundamental theorem to equations having one or more complex roots, rational roots or multiple roots.

• Relations between roots and coefficients of a polynomial equation and computation of symmetric functions of roots. Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots.

• Analytical methods for solving polynomial equations of order up to four-quadratic formula, Cardano's method for solving cubic equations), Ferrari's method (for quartic equations). Remarks about the insolvability of equations of degree five or more. Finding the nature of roots without solving-Des Cartes' rule of signs.

Distribution of instructional hours:

Module 1: 22 hours; Module 2: 23 hours
Module 3: 22 hours; Module 4: 23 hours

Text for Module 2: Howard Anton, et al, Calculus. Seventh Edition, John Wiley

Text for Module 3: Kreyzig, Advanced Engineering Mathematics, 8th edition, John Wiley.

Text for Module 4: Barnard and Child, Higher Algebra, Macmillan.

References:

1. James Stewart, Essential Calculus, Thompson Publications, 2007.
2. Thomas and Finney, Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley.
3. Peter V. O' Neil, Advanced Engineering Mathematics, Thompson Publications, 2007
4. Michael D. Greenberg, Advanced Engineering Mathematics, Pearson Education, 2002.
5. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, 2003.

SEMESTER III: Auxiliary Course in Mathematics for Chemistry and Industrial Chemistry

Code: MM 1331.7 Instructional hours per week: 5
No. of Credits: 4

Mathematics-III
(Vector Differentiation, Coordinate systems, Abstract Algebra and Fourier Series and transforms)

Module 1: Vector Differentiation

• (Review only) Vectors in 3-space. Addition of two vectors, multiplication of a vector by a scalar and basic properties of these operations. Representation in Cartesian coordinates using standard basis. Dot, cross and triple product of vectors, their significance and properties.
• Vector function of a single variable and representation in terms of standard basis. Limit of a vector function and evaluation of limit in Cartesian representation. Continuous vector functions and the idea that such functions represent oriented space curves. Examples.
• Derivative of a vector function and its geometric significance. Derivative in terms of Cartesian components. Tangent vector to a curve, smooth and piecewise smooth curves. Applications to finding the length and curvature of space curves, velocity and acceleration of motion along a curve etc.
• Scalar field and level surfaces. The gradient vector of a scalar field (Cartesian form) at a point and its geometric significance. Gradient as an operator and its properties. Directional derivative of a scalar field and its significance. Use of gradient vector in computing directional derivative.
• Vector fields and their Cartesian representation. Sketching of simple vector fields in the plane. The curl and divergence of a vector field(Cartesian form) and their physical significance. The curl and divergence as operators, their properties. Irrotational and solenoidal vector fields. Various combinations of gradient, curl and divergence operators.

Module 2: Coordinate systems

• Conic sections in polar coordinates. Eccentricity of an ellipse as a measure of flatness. Polar equations of conics. Sketching conics in polar coordinates. Kepler's Laws. Example 4 of section 11.6.
• Triple integrals over bounded regions in three space. Evaluation by iterated integrals. Cylindrical coordinates and spherical coordinates and their relation to Cartesian coordinates. Use of cylindrical and spherical co-ordinates in evaluating triple integrals. Applications of triple integrals to finding volumes of solid objects.
• Spherical co-ordinates, polar co-ordinates, cylindrical co-ordinates, relation

to cartesian co-ordinates, application of integration, integration in spherical co-ordinates.

Module 3: Laplace transforms

Laplce transform-Laplace transform as a linear integral transform, Properties of the Laplace transform, Finding the Laplace transform of a function, inverse Laplace transform, Convolution theorem, Laplace transform of derivatives and integrals, Applications to the solution of simultaneous differential equations.

Module 4: Series solution of differential equations

Power series solution of first order homogeneous differential equations, power series solution of second order equations, ordinary points, regular singular points, Frobenius polynomial, Rodrigue's formula, Bessel's differential equation, Bessel functions of the first and second kind, properties of Bessel functions.
Text for Modules 1 and 2: Howard Anton, et al, Calculus. Seventh Edition, John Wiley
Text for Modules 3 and 4: Kreyzig, Advanced Engineering Mathematics, 8th edition, John Wiley.

References:

1. James Stewart, Essential Calculus, Thompson Publications, 2007.
2. Thomas and Finney, Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley.

Distribution of instructional hours:

Module 1: 27 hours; Module 2: 27 hours
Module 3: 18 hours; Module 4: 18 hours

SEMESTER IV: Auxiliary Course in Mathematics for Chemistry and Industrial Chemistry

Code: MM 1431.7 Instructional hours per week: 5
No. of Credits: 4

Mathematics-IV
(Linear transformations, Vector integration¡ Abstract Algebra, Fourier Series and Transforms)

Module 1: Linear Transformations

• Linear transformations from R_n into R_m. Matrix of alinear transformation relative to a given pair of bases and linear transformation defined by a matrix. Characterisation of linear transformationsfrom R_n into R_m.
• Linear transformations from R_n into R_n and matix of suchtranformations. Matrix representation of simple tranformations such as rotation,

reflection, projection etc. on the plane. Relation between matricesof a given transformation relative to two different bases. Method of choosing a suitable basis in which the matrix of a given transformation has the particularly simple form of a diagonal matrix.

Module 2: Vector Integration

• The method of computing the work done by a force field in moving a particle along a curve leading to the definition of line integral of a vector field along a smooth curve. Scalar representation of line integral. Evaluation as a definite integral. Properties. Line integral over piecewise smooth curves. Green's theorem in the plane (without proof) for a region bounded by a simple closed piecewise smooth curve.
• Oriented surfaces. The idea of flux of a vetor field over a surface in 3-space. The surface integral of a vector field over a bounded oriented surface. Evaluation by reducing to a double integral. Use of cylindrical and spherical co-ordinates in computing surface integral over cylindrical and spherical surfaces.
• Stokes' theorem (without proof) for an open surface with boundary a piecwise smooth closed curve. Gauss' divergence theorem (without proof). Verification of the theorems in simple cases and their use in computing line integrals or surface integrals which are difficult to evaluate directly. Physical intrepretation of divergence and curl in terms of the velocity field of a fluid flow.
• Conservative fields and potential functions. Relation of conservative vector fields to their irrotational nature and the path- independence of line integrals in the field (without proof). Significance of these results in the case of conservative force fields such as gravitational, magnetic and electric fields. Method of finding the potential function of a conservative field.

Module 3: Abstract algebra

• Groups–definition and examples, elementary properties, finite groups and subgroups, cyclic groups, elementary properties, symmetry of plane figures
• Rings and fields–definition and examples,
• Vector spaces, definition and examples, elementary properties, linear dependence and independence, basis and dimension.

Module 4: Fourier Series and transforms

• Periodic functions, trigonometric series, Fourier series, evaluation of Fourier coefficients for functions defined in (- 1,+1), Fourier series for odd and even functions, half range series, Fourier series for odd and even functions, Fourier series of functions defined in (- L,+L).
• Fourier integrals and Fourier transforms.

Text for Module 1: David C. Lay, Linear Algebra, Thompson Publications, 2007.
Text for Module 2: Howard Anton, et al, Calculus. Seventh Edition, John

Wiley
Text for Module 3: J B Fraleigh, A First Course in Abstract Algebra, Narosa Publications
Text for Module 4: Kreyzig, Advanced Engineering Mathematics, 8th edition, John Wiley.

References:

1. James Stewart, Essential Calculus, Thompson Publications, 2007.
2. Thomas and Finney, Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley.
3. Peter V. O' Neil, Advanced Engineering Mathematics, Thompson Publications, 2007
4. Michael D. Greenberg, Advanced Engineering Mathematics, Pearson Education, 2002.

Distribution of instructional hours:

Module 1: 27 hours; Module 2: 27 hours
Module 3: 18 hours; Module 4: 18 hours