UNIVERSITY OF CALICUT

(Abstract)

B.Sc programme in Chemistry under Choice Based Credit Semester System - Scheme and Syllabus – implemented with effect from 2009 admission – approved – Orders issued.

GENERAL AND ACADEMIC BRANCH – I 'J' SECTION

No. GA I/J2/7811/07 Dated, Calicut University. P.O., 23.06.2009.

Read: 1. U.O.No.GAI/J2/3601/08 Vol.II dated 19.06.2009.
2. Minutes of the meeting of the Board of Studies in Chemistry (UG) held on 30.01.2009 and 29.04.2009.
3. Minutes of the meeting of the Faculty of Science held on 05.05.2009 Item No.2 (viii).
4. Item No.II A (9) of the minutes of the meeting of the Academic Council held on 14.05.2009.

O R D E R

Choice Based Credit Semester System and Grading has been introduced for UG curriculum in the affiliated colleges of the University with effect from 2009 admission onwards and the Regulation for the same implemented vide paper cited 1st above.

Vide paper read as 2nd above, the Board of Studies in Chemistry (UG) approved the syllabus of B.Sc Programme in Chemistry under Choice Based Credit Semester System and also approved the draft regulation for Choice Based Credit Semester System (UG).

The Faculty of Science vide paper read as 3rd endorsed the minutes of the meetings of the Board of Studies in Chemistry (UG).

The Academic Council, vide paper read as 4th above, approved the minutes of the Faculty of Science.

Sanction has therefore been accorded for implementing the Scheme and Syllabus of B.Sc programme in Chemistry under Choice Based Credit Semester System in the University with effect from 2009 admission onwards.

Orders are issued accordingly. Syllabus is appended.

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For REGISTRAR.

To
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SECTION OFFICER

UNIVERSITY OF CALICUT

BSc. PROGRAMME IN CHEMISTRY

(RESTRUCTURED CURRICULUM JUNE 2009)

Preface

Science education is central to the development of any society. This can be achieved only by revamping the undergraduate teaching to make it effective and meaningful. This requires a curriculum, appropriate to achieve the goal. The curriculum, thus should contain the necessary aspects to i) make the students creative ii) emphasize the scientific method which has helped in solving problems iii) make aware of those aspects of science that are environmental based and life centered iv) develop the mental faculty of open mindedness and v) train students in the use of equipments in chemistry laboratories.

The Higher Education Council of Kerala has taken the initiative to remodel the undergraduate syllabus by introducing the credit and semester system at this level also. This approach has necessitated the revision of syllabus of all subjects. Chemistry, being a border science both to biology, physics and engineering has significant role to play. With this fact the syllabus of undergraduate courses in chemistry has been revised with participation of large number of teachers, experts and industrialists. It is hoped that the new approach will empower our future students to meet the challenges of tomorrow.

UNIVERSITY OF CALICUT
RESTRUCTURED CURRICULUM FOR B.Sc. PROGRAMME IN CHEMISTRY

Course Structure (Total Credits : 120)

Semester I

Exam : 3 hrs (Internal 25%; External 75%); Total Credits : 19

No.	Code No	Course Title	Hrs/ Week	Total Hrs	Credit
1	A01	Communicative skills in English	5		3
2	A02	Critical reasoning,writing & presentation	4		3
3	A07	Communication skills in other languages	4		4
4	CH1B01	**Core Course 1 Foundations in Chemistry**	**2**	**36**	**2**
5	CH1B02(P)	**Core Course Practical-I (Volumetric Analysis)**	**2**	**36**	**--**
6	PH1C01	1st Complimentary Course – Physics I	2		2
7	PH1C02(p)	1st Complementary Course – Practical Physics I	2		--
8	MA1C01	2nd Complementary Course – Maths I	4		3
			25 hrs		17 Credits

Semester II

Exam : 3 hrs (Internal 25%; External 75%); Total Credits : 19

No.	Code No	Course Title	Hrs/ Week	Total Hrs	Credit
1	A03	Reading literature in English	5		4
2	A04	Readings on Indian constitution,secularism and sustainable environment	4		4
3	A08	Transalation & communicationin other languages	4		4
4	CH2B03	**Core Course II Theoretical Chemistry**	**2**	**36**	**2**
5	CH2B04(P)	**Core Course II Practicals-II (Volumetry)**	**2**	**36**	**--**
6	PH2C03	1st Complementary Course Physics II	2		2
7	PH2C04(P)	1st Complementary Course – Practical Physics II	2		--
8	MA2C02	2nd Complementary Course – Maths II	4		3
			25 Hrs		19 Credits

Semester III

Exam : 3 hrs (Internal 25%; External 75%); Total Credits : 16

No.	Code No	Course Title	Hrs/ Week	Total Hrs	Credit
1	A05	Literature and contemporary issues	5		4
2	A09	Literature in other languages	5		4
3	CH3B05	**Core Course III Physical Chemistry I**	**3**	**54**	**3**
4	CH3B06(P)	**Core Course Practicals-III (Volumetry)**	**2**	**36**	
5	PH3C05	1st Complementary Course Physics III	3		2
6	PH3C06(P)	1st Complementary Course Practicals III	2		--
7	MA3C03	2nd Complementary Course – Maths III	5		3
			25 hrs		16 credits

Semester IV

Exam : 3 hrs (Internal 25%; External 75%); Total Credits : 24

No.	Code No	Course Title	Hrs/ Week	Total Hrs	Credit
1	A06	History and philosophy of science	5		4
2	A10	Culture and civilization	5		4
3	CH4B07	**Core Course IV Organic Chemistry I**	**3**	**54**	**3**
4	CH4B08(P)	**Core Course Practical -IV (Volumetry)**	**2**	**36**	**4**
5	PH4C07	1st Complementary Course Physics IV	3		2
6	PH4C08(P)	1st Complementary Course Practicals IV	2		4
7	MA4C04	2nd Complementary Course Maths IV	5		3
			25 hrs		24 credits

Semester V Exam : 3 hrs (Internal 25%; External 75%); Total Credits : 19

No.	Code No	Course Title	Hrs/ Week	Total Hrs	Credit
1	CH5B09	Core Course V Inorganic Chemistry I	3	54	3
2	CH5B10	Core Course VI Organic Chemistry II	3	54	3
3	CH5B11	Core Course VII Physical Chemistry II	4	72	3
4	CH5B12(P)	Core Course V Practical (Inorganic qualitative analysis)	5	90	4*
5	CH5B13(P)	Core Course Practical-VI (Organic analysis and preparation)	5	90	4*
6	CH5D01 CH5D02 CH5D03	Open Course I (Soft courses offered to students other than Chemistry main students) Environmental Chemistry / Chemistry in Everyday Life / Plastics and Rubbers in everyday life	3	54	4
7	CH5B14(Pr)	Course work / Project / Industrial visit	2	36	
			25 hrs		21 credits

* Exam will be held at the end of 6th semester

Semester VI Exam : 3 hrs (Internal 25%; External 75%); Total Credits : 23

No.	Code No	Course Title	Hrs/ Week	Total Hrs	Credit
1	CH6B15	Core Course VIII Inorganic Chemistry II	3	54	3
2	CH6B16	Core Course IX Organic Chemistry III	4	72	3
3	CH6B17	Core Course X Physical Chemistry III	3	54	3
4	CH6B18(P)	Core Course Practical- VII (Physical chemistry)	5	90	4
5	CH6B19(P)	Core Course Practicals - VIII (Gravimetric Estimation)	5	90	4
6 * **	CH6B20(E1) CH6B20(E2) CH6B20(E3) CH6B20(E4) CH6B20(E5)	Elective Course 1.Analytical Chemistry 2. Synthetic Organic Chemistry 3. Environmental Chemistry 4. Chemistry and Technology of Polymers 5. Industrial chemistry	3	54	2
7	CH6B21(Pr)	Course work / Project	2	36	4
			25 hrs		23 credits

*Bsc(polymerchemistry)

**BSc(Industrialchemistry)

COURSE STRUCTURE
COMPLEMENTARY COURSE IN CHEMISTRY TO OTHER MAIN STUDENTS

Semester	Code No	Course Title	Hrs/ Week	Total Hrs	Credit
I	CH1C01	General Chemistry	2	36	2
	CH1C02(P)	Complementary practical I	2	36	-
II	CH2C03	Inorganic and Physical Chemistry	2	36	2
	CH2C04(P)	Complementary practical II	2	36	-
III	CH3C05	Organic and biochemistry	3	54	2
	CH3C06(P)	Complementary practical III	2	36	-
IV	CH4C07	Physical chemistry	3	54	2
	CH4C08(P)	Complementary practical IV	2	36	4
		Total	18	324	12

WORK AND CREDIT DISTRIBUTION STATEMENT

	Course Title	1st Sem		2nd Sem		3rd Sem		4th Sem		5th Sem		6th Sem		Total Credits
		Hrs/ week	Credit	Hrs/ week	Credit	Hrs/ week	Credit	Hrs/ week	Credit	Hrs/ week	Credit	Hrs/ week	Credit	
1	Common Course (English)	9	6	9	8	5	4	5	4	--	--	--		22
2	Common Course (IInd Language)	4	4	4	4	5	4	5	4	--	--	--		16
3	Core Course (Theory)	2	2	2	2	3	3	3	3	10	9	10	9	28
	(Practicals)	2	--	2	--	2	--	2	4	10	8	10	8	20
4	1st Complimentary (Theory)	2	2	2	2	3	2	3	2	--				8
	(Practicals)	2	--	2	--	2	--	2	4	--				4
5	2nd Complimentary (Theory)	4	3	4	3	5	3	5	3	--				12
6	Open Course	--	--	--	--	--	--	--	--	3	4	--	--	4
7	Elective Course	--	--	--	--	--	--	--	--	--	--	3	2	2
8	Project / Course work	--	--	--	--	--	--	--	--	2	--	2	4	4
Total Credit			19		19		16		24		19		23	120
		120 Credits												

Core Course : 50 Credits Language : 38 Credits Complimentary : 24 credits Project : 4 credits Open course :4

Scheme of Instruction

For the B.Sc. Chemistry programme, Chemistry forms the core course. It is to be taught during all the six semesters.Both theory and practicals are included for study during the six semesters.

A.Theory

The total number of core theory courses is eleven,one course each during the first four semesters, three courses each during fifth and sixth semesters and one elective course in the sixth semester.

In the fifth semester under open course for students from other streams, three courses are prescribed .

1. Environmental chemistry
2. Chemistry in everyday life
3. Plastics and rubbers in everyday life

In the sixth semester there are five elective courses. An institution can chose any one of the following.

1. Analytical Chemistry
2. Synthetic Organic Chemistry
3. Environmental Chemistry
4. Polymer Chemistry and technology (for B.Sc.Polymer chemistry students)
5. Industrial Chemistry (for B.Sc. Industrial chemistry students)

B.Practical

Practicals corresponding to each core course will be conducted during the corresponding semesters. A combined examination relating to the first four core course practicals will be held at the end of the fourth semester. Other core course practical examination will be held at the end of sixth semester. All practical examinations are of three hour duration . A duly certified record of practicals should be submitted during the examination.

C.Project

Project works will be carried out in fifth and sixth semesters (two hours per week). Not more than ten students can form a group and undertake a project. Each individual student should submit a copy of the project report duly attested by the supervising teacher and the Head of the department.

SEMESTER I

SEMESTER I - CORE COURSE I
FOUNDATIONS IN CHEMISTRY (36 HOURS)
CREDIT – 2 (2HOURS/WEEK)

Preamble

The students of undergraduate programme in Chemistry should be exposed to the different methodologies used in science.. Therefore, one module each on methodology in science and methodology in chemistry is introduced which helps the student to get an idea on the tactics and strategies to be adopted in chemistry. Here a detailed study is not expected, instead an introduction on the terms and concepts in chemistry is visualized.

From a historical point of view Inorganic Chemistry is synonymous with general chemistry. An inorganic chemistry student is expected to be conversant with the chemistry of all the elements and has been closely allied with analytical chemistry, with physical chemistry and even with organic chemistry. By considering the rapid development in the field of inorganic chemistry since the late 1950's it has become necessary that an undergraduate chemistry student should gain perspective on the past, without compromising the modern developments. The present syllabus has been so designed as to fulfill both these aspects.

Module 1: Methodology and Perspectives of Sciences(6 hours)

Types of knowledge: Practical, theoretical and scientific knowledge. What is science? – What is not science? – Hypothesis – theories and laws in science – observations, evidences and proofs.

Science as a human activity, scientific temper vocabulary of science – science disciplines. Revolutions in sciences and technology.

References

1. Gieryn T.F *Cultural Boundaries of Science* Univ.Chicago Press 1999.
2. Collins H and T.Pinch "*The Golem what everyone should know about science'* Cambridge Univ. Press 1993.
3. Hewitt, Paul G, Suzanne Lyons, John A Suchocki and Jennifer Yeh *Conceptual Integrated Science* Addison – Wesley, 2007.
4. Jeffrey A Lee The Scientific Endeaver: *A premier on Scientific principles and practice* Pearson Education

Module II: Methodology in chemistry (12 hrs)

General introduction – history and development of Chemistry - different branches of Chemistry – relevance of chemistry in everyday life. Applications in

different fields - industry, agriculture, food, medicine, textile, building materials (paint, cement etc), plastics, rubber, etc. Power generation by chemical methiods such as fission and fusion reactions - solar cells, biofuel feedstocks-sugar/starch/plant and animal fats biodiesel. Some chemically and biologically important systems, water-its unique features, hydrogen bonding etc.

Mention about metals, nonmetals and metalloids, combination of atoms. Different types of bonding (ionic, covalents, coordinate). Comparison of physical properties with chemistry. Organic Chemistry- Chemistry of Carbon compounds catenation – isomerism – vital force theory – purity of organic compounds – classification – functional group – biomolecules – natural products –The concept of polymers, supramolecules and nanomaterials in chemistry.

Module III: Periodic classification (9 hrs)

Modern periodic law – long form periodic table – Periodicity in properties – Atomic, ionic, covalent radi – ionisation potential, electron affinity, – Electronegativity – Paulings, Mulliken, Allred Rochow's Scale of electronegativity.

Radius ratio – Effective nuclear change – Screening effect – Slater rules

Anomalous behaviour of 1^{st} element of a group – diagonal relationship.

Module IV: Nuclear Chemistry (9 hrs)

Natural radioactivity – Modes of decay – group displacement law – theories of disintegration – Rate of decay – Decay constant – Half life period – Gieger Nuttal rule – Radioactive equilibrium – Disintegration series – Transmutation reactions – using protons, deutrons, α-particles and neutrons – Artificial radioactivity – Positron emission and K electron capture – Synthetic elements.

Nuclear stability – N/P ratio – Packing fraction – Mass defect – binding energy – nuclear forces – exchange theory and nuclear fluid theory – Nuclear fission – fusion – hydrogen bomb – atomic bomb – nuclear reactor.

Isotopes – detection – Aston's mass spectrograph – separation of isotopes – Gaseous diffusion method – thermal diffusion method – Application of radioactive isotopes – ^{14}C dating – rock dating – isotopes as tracers – study of reaction mechanism (ester hydrolysis) – Radio diagnosis and radiotherapy.

Text Books

1. C.N.R.Rao - *Understanding Chemistry* , University Press(India) Pvt.Ltd.
2. Puri, Sharma & Kalia, *principles of Inorganic Chemistry*, Milestone Publishers and Distributors, 2008.

3. John Mills & Peter Evans, *Core Chemistry* foundation books Pvt.Ltd, New Delhi 2004 (reprint).
4. Richard Harwood *New Edition Chemistry* Cambridge University Press India Pvt Ltd New Delhi 2008 (reprint).
5. P.L. Soni, *Text book of Inorganic Chemistry*, Sultan Chand and Sons, 2007.
6. S. Glasston, *Source Book on Atomic Energy*, 3rd Edn., East-West Press Pvt. Ltd., 1967.

References

1. J.D. Lee, *Concise Inorganic Chemistry*, 5th Edition, Oxford University Press N Delhi, 2008.
2. Cotton F.A. and Wilkinson, *Advanced Inorganic Chemistry*, Wiley Indian Pvt. Ltd., 2008.
3. J.E. Huheey, *Inorganic Chemistry*, Derling Kindersley (India) Pvt. Ltd., 2006.
4. Shriver and Atkins, *Inorganic Chemistry*, Wh Freeman and Company, 2006.
5. Garry L. Milessler and Donald A. Tarr, *Inorganic Chemistry*, Prentice Hall, 2003.
6. H.J.Arinikar *Essentials of Nuclear Chemistry*, 4th edition New Age International, New Delhi, 1995.
7. J.B.Rajam *Atomic Physics*, S.Chand and Co.Pvt.Ltd, 1974.

SEMESTER II

SEMESTER II – CORE COURSE II
THEORETICAL CHEMISTRY (36 HOURS)
CREDIT – 2 (2HOURS/ WEEK)

Preamble

Properties of bulk matter can be examined from the viewpoint of thermodynamics. But it is essential to know how these properties stem from the behaviour of individual atoms and molecules. The laws of quantum mechanics decide the properties of the micro-world. There are two approaches for introducing quantum mechanics. One is to follow the historical development of the quantum theory and the other is to begin from the basic principles of the theory straightaway. The course follows the first path since it is interesting and students can better appreciate the gradual emergence of the theory. Module I introduces the evolution of the theory from the above viewpoint. After studying this module, the student realizes the failures of classical physics theories in explaining the micro-world and he admits that a new theory is the need of the hour, which is quantum theory. Module II deals with the basic principles (the postulates) involved in quantum mechanics and introduces the Schrödinger wave equation. After completing the module, the student knows how to solve the time-independent Schrödinger wave equation of different systems. The major objective of this module is to give him the message that wave functions of the hydrogen atom are nothing but orbitals.

Molecules are formed from the combination of atoms. In Module III, the student learns the different approximation methods to combine the wave functions of two atoms, namely the valence bond method and the molecular orbital method. Thus he gets an idea of the quantum mechanical treatment of chemical bonding in diatomic molecules.

Module IV is an extension of the idea developed above to polyatomic molecules through the concept of hybridization (linear combination of orbitals of the same atom). The latter part of the module explains the formation of bands from the atomic orbitals in metals.

The course aims to inculcate an atomic/molecular level thinking in the minds of the students.

Module I: Dawn of Quantum Theory (9hrs)

Introduction based on historical development – John Dalton's atomic theory, earlier atom models. Failure of classical physics – black body radiation, Planck's quantum hypothesis, photoelectric effect, generalisation of quantum theory. Bohr theory of atom – calculation of Bohr radius, velocity and energy of an electron. Atomic spectra of hydrogen and hydrogen like atoms. Limitations of Bohr theory. Sommerfeld modification.

Louis de Broglie's matter waves – wave-particle duality. Electron diffraction. Heisenberg's uncertainty principle.

Module II: Introductory Quantum Chemistry (9hrs)

Operator algebra – linear and Hermitian operators, Laplacian and Hamiltonian operators, eigen functions and eigen values of an operator. Postulates of quantum mechanics. Well behaved functions.

Time independent Schrödinger wave equation. Application to particle in a one dimensional box – normalization of wave function. Particle in a three-dimensional box – separation of variables, degeneracy.

Application of Schrödinger wave equation to hydrogen atom. The wave equation in spherical polar coordinates (mention only). Separation of variables. Radial and angular functions. Orbitals. Quantum numbers (n, l, m).

Radial functions and Radial distribution functions and their plots, Angular functions and their plots (1s, 2s and $2p_z$ only).

Need for approximation methods in multi-electron systems.

Module III: Bonding in diatomic molecules (9hrs)

Born-Oppenheimer approximation. Variation theorem (mention only). Quantum mechanical concept of bonding – LCAO approximation. Valence bond theory of H_2 molecule (Derivation not required). Molecular orbital theory of H_2^+ molecule (Derivation not required). Potential energy diagram of H_2 molecule formation – equilibrium geometry. Bonding and anti bonding molecular orbitals, bond order. MO diagrams of homonuclear and heteronuclear diatomic molecules – He_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, CO and NO. Comparison of VB and MO theories.

Module IV: Bonding in polyatomic molecules (9hrs)

Concept of Hybridization:

Definition, need of hybridization. LCAO of the central atom – coefficients of atomic orbitals in the linear combination (derivation not required). sp hybridization – BeH_2, sp^2 hybridisation – BH_3, sp^3 hybridisation – CH_4. Application of hybridization concept – geometry of molecules like PCl_5, SF_6 and IF_7.

Bonding in metals:

Qualitative idea of free electron approximation and tightbinding approximation. Formation of bands in a one-dimensional solid. Fermi level. Explanation of electrical properties using these models.

Text Books

1. D.A. McQuarrie and J.D. Simon, *Physical Chemistry – A Molecular Approach*, Viva, 2001.
2. A.K. Chandra, *Introduction to Quantum Chemistry*, Tata McGraw-Hill, 1994.
3. R.K. Prasad, *Quantum Chemistry*, 2nd Edition, New Age International, 2000.
4. Day and Selbin, *Theoretical Inorganic Chemistry*, East West Press, 2002.
5. Manas Chanda, *Atomic structure and the Chemical Bonding*, Tata McGraw Hill, 2007.

References

1. P.W. Atkins and R.S. Friedman, *Molecular quantum mechanics*, 3rd Edition, Oxford University Press, 1997.
2. I.N. Levine, *Quantum Chemistry*, 5th Edition, Pearson Education Inc., 2003.
3. D.A. McQuarrie, *Quantum Chemistry*, University Science Books, 1983.
4. Jack Simons, *An Introduction to Theoretical Chemistry*, Cambridge University Press, 2005.

SEMESTER III

SEMESTER III - CORE COURSE III

PHYSICAL CHEMISTRY I (54 HOURS)

CREDIT - 3(3 HOURS/ WEEK)

Preamble

Science is a systematised form of common sense and logic. A teacher does not periphrasis what he intended to teach, but it should permeate into the student, so that teaching learning process might be enjoyable and complementary. The objective of this academic plan is to make the concepts and methods of physical chemistry clear and interesting to students, who have basic ideas in mathematics and physics. The underlying theory of chemical phenomena is completed, and so it is a challenge to make the most important concepts and methods understandable to undergraduate students. Planning is a prelude to rational action, the axion we uphold while preparing this academic plan (syllabus) for Physical Chemistry. The three papers in physical chemistry are included as three core courses (core course – III, core course VII), core course X) for which 180 lecturer hours are allotted and carries a total of nine credits. Core course III (Physical Chemistry - I) covers topics like Gaseous state, Thermodynamics, Statistical Thermodynamics etc. Core Course VIII (Physical Chemistry II) covers topics like solid state, Molecular Spectroscopy, Phase equilibria, surface chemistry etc. Core course X (Physical Chemistry – III) deals with topic like, Chemical Kinetics, Photochemistry, Electrochemistry, Computers etc.

Module I: Gaseous State (12 Hrs)

Kinetic molecular model of gases – Maxwell distribution of velocities and its use in calculating molecular velocities (average rms and most probable velocity and average kinetic energy) - Collision diameter, mean free path and viscosity of gases including their pressure and temperature dependence – Relation between mean free path and coefficient of viscosity – Behaviour of real gases – deviation of gases from ideal behaviour – Compressibility factor – Van der Waal's equation of state. its derivation and application in explaining ideal gas behaviour – virial equation of state – Van der Waals equation expressed in virial form and calculation of Boyle temperature – Isotherms of real gases and their comparison with Van der Waal's isotherms – Determination of molecular mass by limiting density method – critical phenomena – critical constants and determination.

Module II : Liquid State (6 hrs)

Vapour pressure – determination of vapour pressure Surface Tension – determination – Parachor – determination, application to structure elucidation of compounds viscosity – determination of molecular mass from viscosity measurements – refraction – refractive index – molar refraction and optical exaltation – application to structure elucidation.

Module III : Thermodynamics (18 hrs)

Definition of thermodynamic terms – types of systems – intensive and extensive properties – State and path functions – Zeroeth law of thermodynamics.

First law of thermodynamics – concept of heat, work, internal energy and enthalpy – heat capacity relation between Cp and Cv – Expansion of an ideal gas – work done in reversible isothermal and adiabatic expansion – calculation of W, q, ΔE, ΔH for expansion of an ideal gas under isothermal and adiabatic conditions – Reversible isothermal expansion of a real gas – Joule - Thomson effect – Liquifaction of gases – derivation of the expression for Joule Thomson coefficient – Inversion temperature.

Second law of thermodynamics – Limitations of first law and need for second law – different statements of the law – Carnot cycle – efficiency of a heat engine – Carnot theorem – Concept of entropy – Entropy changes in isothermal expansion of an ideal gas – Entropy changes in phase changes – Calculation of entropy change of an ideal gas with change in P, V and T – Entropy changes of an ideal gas in different processes – entropy of mixing – standard entropies.

Work and free energy functions – Maxwell relationships – Criteria for reversible and irreversible processes – Gibbs–Helmholtz equation – Partial molar free energy – Concept of chemical potential – Gibbs - Duhem equation – Clapeyron equation – Clapeyron – Clausius equation – Its application.

Concept of fugacity and Concept of activity and activity coefficient.

Third law of thermodynamics – Nernst heat theorem – statement of third law – Concept of residual entropy – and absolute entropies (Elementary idea only).

Module IV : Statistical Thermodynamics (9 hrs)

Need for statistical approach – Permutations and combinations – Distribution – Probability – Relation between entropy and probability – Sterling approximation – Types of particles – Boson, Fermion, Boltzmannons – Microstate – most probable distribution – derivation of Maxwell–Boltzmann distribution law – Statistical weight factor (gi)definition of partition function Q – Relation between thermodynamic functions and Q Molecular partition functions (q) factorisation of partition function – derivation of translational partition function and calculation of entropy and internal energy, by translational mode.

Module IV : Chemical Equilibria (9 hrs)

Law of mass action-equilibrium constant – Relation between Kp, Kc and Kx – Thermodynamic treatment of the law of mass action – Vant Hoff reaction isotherm – Temperature dependence of the equilibrium constant – The Van't Hoffs equation – Pressure dependence of the equilibrium constant Kp– Study of heterogeneous equilibria – Factors that change the state of equilibrium – Le –chatelier's principle and its application to chemical and physical equilibria.

References

Text Books

1. Puri BR, Sharma LR, Pathania, *Principles of Physical Chemistry*, Vishal Publishing, Co, 2008.
2. R.L. Soni Dharmaraha, *Physical Chemistry*.
3. Neggi, N.L., *Physical Chemistry*.
4. Gurdeep Raj, *Physical Chemistry*.
5 G.S.Rush Brooke, *Statistical Mechanics*, Oxford University Press
6 T.L. Hill, *Introduction to Statistical Thermodynamics* Addison Wesley

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1. F. Daniels, R.A. Albery, *Physical Chemistry*, 5th Edn, Wiley Eastern, 1980.
2. Moore, W.J., *Basic Physical Chemistry*, 4th Edn., Orient Longmans.
3. Gordon M. Barrow, *Physical Chemistry*, Tata McGraw Hill Edition, 1992, Vth ed.
4. K.L. Kapoor, *Physical Chemistry*, Vol. I, II, III, IV, V, Mac Millan.
5. S. Glasstone, *Physical Chemistry*, Mac Millan & Company, 1962.
6. Rastogi, RD, *Introduction to Chemical Thermodynamics*, 6th Edn, Vikas Publishing House, Pvt. Ltd., 2002.
7. Rajaram and Kuriakkose, *Thermodynamics*, East-West, 1986.
8. Atkins, P.W. *Physical Chemistry*, 8th Edition, Oxford University Press, N Delhi, 2006.

SEMESTER IV

SEMESTER IV - CORE COURSE IV

ORGANIC CHEMISTRY – I (54 HOURS)

CREDIT 3 (3 HOURS/WEEK)

Preamble

The study of Organic Chemistry continues to move ahead on many fronts. Thousands of organic compounds especially biologically active are added in the literature even on daily basis. New journals in the field of Organic Chemistry continue to appear and older one increase in frequency. For a thorough understanding in Organic Chemistry an undergraduate student be exposed to three fundamental aspects: reactions, mechanism and structure. The curriculum is so designed as to fulfill these objectives. The philosophy adapted in choosing the topics is to provide sufficient Chemistry for the reactions and also to minimize the unnecessary repetition of materials found in higher secondary classes.

Module I : Hydrocarbon I (9 hrs)

Structure and Bonding of alkanes. Hybridization and shapes of simple molecules – methane, ethane, ethylene, acetylene – polarity of bonds – Inductive effect, electromeric effect, hyperconjugation, resonance, steric effect – rules for resonance forms and techniques of drawing resonance forms – curved arrow formalism – nomenclature of alkanes – source of hydrocarbons – methods of formation – Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation – Properties of alkanes – oxidation and chlorination.

Module II : Hydrocarbon II (9 hrs)

cis-trans isomerism of cycloalkanes – conformation of ethane, n-butane – Newmann projection, Saw-horse formula, Fischer and flying wedge formula – Conformation of cycloalkanes – ring strains in cyclopropane and cyclobutane –Bayers strain theory – conformations of monosubstituted cyclohexane.

Alkynes: Nomenclature – Preparation – Elimination of dihalides – Alkylation of acetylide anioin (preparation of higher alkynes) – Reactions – Addition of HX, H_2O, reduction and oxidative cleavage – Acidity of alkynes.

Module III : Introduction to organic reaction mechanisms (9 hrs)

Hydrocarbons III: Nomenclature – industrial preparation and uses of alkenes – calculation of degree of unsaturation – cis-trans isomerisms – E-Z designation – electrophilic addition reaction – mechanism of addition of hydrogen halides and halogen to alkenes – Markownikoff's rule – Peroxide effect – mechanisms. Synthesis from alcohols and alkyl halides.

Reactions: conversion to alcohols by hydroboration, oxymercuration, hydrogenation, halohydrin formation, cis-hydroxylation, ozonolysis and oxidation with HIO_4. Industrial applications of ethylene and propylene – Preparation of polymers. Important natural products – with structure and uses of terpenoids' citral, geraniol, vitamin A, limonene (Structural elucidation not required).

Module IV : Alkenes (9 hrs)

Types of organic reactions – polar reactions and radical reactions – types of reagents – electrophiles and nucleophiles – reaction intermediates – carbocation, carbanions, free radicals, carbenes, nitrenes (with examples) – their structure, hybridization stability and reactions (one each).

Preparation properties and applications of addition polymers like Polyethylene, PVC, PTFE, Polypropylene and PMMA – Structure and composition of natural rubber.

Module V : Stereochemistry (9 hrs)

Optical activity – Specific rotation and enantiomeric excess – chirality and elements of symmetry – enantiomers –diastereomers – lactic acid, glyceraldehyde - tartaric acid - aldotetroses- D-L and R-S configurations.

Meso compounds – Racemic mixtures and resolution – optical isomerism of compounds without asymmetric carbon atoms – Allenes and biphenyls – asymmetric synthesis.

Module VI : Benzene and Aromaticity (9 hrs)

Nomenclature – structure and stability of benzene – molecular orbital description – Aromaticity and Huckel's rule – Naphthalene, Anthracene – Haworth synthesis of naphthalene. Reactions of benzene. Electroplhilic substitution reactions with mechanism – Halogenation, nitration, sulphonation, Friedel-Craft's reaction orientation effect of substituents – Nitration and sulphonation of naphthalenes with mechanism. Oxidation and reduction of aromatic compounds – side chain oxidation, catalytic hydrogenation of aromatic rings.

Text Books

1. John McMurry – *Fundamental of Organic Chemistry*. Brook and Cole.
2. Bruice – *Organic Chemistry*, Pearson Education, New Series 2001, 3rd edition.
3. Mark Louden – *Organic Chemistry*, Oxford University Press, Oxford.
4. V.R Gowriker and others '*Polymer Science'* Wiley Eastern Ltd.
5. Saunders *Organic Polymer Chemistry*, Chapman and Hall.

References

1. C.N.Pillai *Organic Chemistry for Undergraduates*, Universities Press (India) Pvt.Ltd, 2008.
2. L.G. Wade, J.R., *Organic Chemistry*, Vth Edn, Pearson Education, Singapore, 2004.

3. Solomons & Fryhle, *Organic Chemistry*, VIIth ed, Wiley India Pvt. Ltd., 2004.

4. I.L. Finar, *Organic Chemistry*, VIth edition, Vol. I & II, ELBS with Longman, Singapore, 1973.

5. Morrison & Boyd, *Organic Chemistry*, VIth ed, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.

6. B.S. Bahl & Arun Bahl, *Adv. Org. Chemistry*., S.Chand & Co.Ltd, New Delhi

7. Tiwari, Mehrothra, Vikas & Vishnoi, *Text book of Organic Chemistry*. Vikas publishing house Pvt.Ltd, New Delhi.

8. M.K. Jain, *Principles of Organic Chemistry.*

9. J.March, *Advanced Organic Chemistry*, John Wiley and sons.

10. T.H Lowry and K.S.Richardson, *Mechanism and Theory in Organic Chemistry,* Harper Collins.

SEMESTER V

SEMESTER V - CORE COURSE V
INORGANIC CHEMISTRY I (54 HOURS)
CREDIT – 3 (3HOURS/WEEK)

Module I: Chemical Bonding (9 hrs)

Ionic bond – Lattice energy of ionic compounds - Born-Lande equation (derivation not expected) – Born-Haber cycle – its applications – Lattice energy – solubility – polarisation of ions – Fajan's rules.

Covalent bond: Valance bond theory – hybridisation – sp, sp^2, sp^3, sp^3d and sp^3d^2 hybridisations – structure of molecules – H_2O, NH_3, XeF_2, XeF_4, SF_4, ClF_3, IF_7, I_3^-, SO_4^{2-}. Polarity of covalent bond – percentage of ionic character – dipole moment and molecular structure.

Module II: Representative elements (12 hrs)

General characteristics of s block elements – electronic configuration, size, density, ionisation energy, melting point, boiling point, flame colour.

General characteristics of p block elements – Electronic configuration, size, oxidation state, ionization energy, electron affinity, electronegativity.

Preparation, properties and structure of diborane, borazine, boric acid, boron nitride and interhalogen compounds (ClF, ICl_3, ClF_3, IF_5 and IF_7). Electropositive character of iodine – separation of noble gases (charcoal adsorption method).

Module III: Metallurgy (12 hrs)

Occurrence of metals based on standard electrode potential – concentration of ores – calcination, roasting and smelting – reduction using carbon and other reducing agents – electrolytic reduction – hydrometallurgy – Ellingham diagram. Refining of metals – electrolytic refining – oxidative refining – zone refining – Van Ankel method.

Extractive metallurgy of Li, Ni, Ti and U – Ferrous metallurgy – manufacture of steel by open hearth process – Alloys – composition and uses of German silver, Brass, Broze, Gunmetal, Alnico.

Module IV: Transition and innertransition elements (9 hrs)

Transition metals – general characteristics – metallic character – oxidation states – size – density – melting and boiling points – ionization energy – colour – magentic properties – reducing properties – catalytic properties – Non stoichiometric compounds – complex formation – alloy formation – difference between first row and other two rows.

Lanthanides – Electronic configuration and general characteristics – occurrence of lanthanides – separation by ion exchange method – lanthanide contraction.

Actinides – Electronic configuration and general characteristics – comparison with lanthanides.

Module V: Theoretical principles of qualitative and quantitative analysis (12 hrs)

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

Primary and secondary standards – standard solutions – theory of titrations involving acids and bases, $KMnO_4$, $K_2Cr_2O_7$, I_2 and liberated I_2. Indicators – Theory of acid-base, redox, adsorption indicators – complexometric titrations.

Precipitation methods: Conditions of precipitation – coprecipitation and post precipitation and washing of precipitates.

Text books

- Puri, Sharma and Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers and Distributors, 2008.
- J.D.Lee, *Concise Inorganic Chemistry*, 5th edition , Oxford University Press, New Delhi 2008.
- R.Gopal, *Inorganic Chemistry for undergraduates*, Universtities press, India Pvt.Ltd, 2009.
- P.L.Soni, *Text book of inorganic Chemistry*, S.Chand and Sons, 2007.
- B.Doughlas, D.H.Mc Danials and J.J.Alexander '*Concepts and models in Inorganic Chemistry'* , Oxford and IBH publishing Co.Pvt.Ltd.

References

1. G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denny, *Vogel's Text book of Quantitative Chemical Analysis*, 5th Edn., ELBS, 1989.
2. DA Skoog, DM West, *Analytical Chemistry, An Introduction*, 4th Edn., CBS Publishing Japan Ltd., 1986.
3. J.E. Hubery, E.a. Keiter, R.L. Keiter, *Inorganic Chemistry*, *Principles, Structure and Reactivity*, Pearson Education, 1990.

SEMESTER V - CORE COURSE VI
ORGANIC CHEMISTRY II (54hrs)
CREDIT – 3 (3HRS/WEEK)

Module I : Halogen Compounds (9hrs)

Nomenclature of alkyl and aryl halides – preparation of alkyl halides – from alcohols and alkenes.

Radical halogenation, alkylic bromination of alkenes – preparation of aryl halides.

Reactions of alkyl halides: Substitution reactions, SN^1 & SN^2 – Mechanism, Kinetics, Energy profile diagram & Stereochemistry.

Reactions of vinyl & allyl halides – elimination of alkyl halides – E_1 & E_2 mechanism – Saytzeff rule.

Reactions of Aryl halides – Nucleophilic aromatic substitution reaction with mechanism – bimolecular displacement mechanism – Elimination – addition mechanism and Addition – elimination mechanism – Benzyne intermediate.

Module II : Organometallic compounds (9hrs)

Preparation of Grignard reagent, Organolithium compounds, Organo zinc compounds, Organo copper compounds.

Reformatsky reaction – Synthesis of organic compounds using Grignard reagent and alkyl lithium.

Alcohols: Nomenclature – Preparation of alcohols – By reduction of carbonyl compounds – reaction of carbonyl compounds with Grignard reagent – Properties of alcohol – Hydrogen bonding – Reactions of alcohols – Dehydration, Conversion to tosylates – Oxidation.

Module III : Phenols (4hrs)

Preparation (from cumene, aromatic sulphonic acid, chlorobenzene).

Properties – Acidity of phenol – uses – reactions (oxidation) to quinones, Riemer-Tiemann reaction – Bromination, Nitration, Liebermann's nitroso reaction, preparation of phenolphthalein, Kolbe's reaction – Pinacol–Pinacolone rearrangement.

Ethers and Epoxides (5hrs)

Nomenclature – Preparation – Williamsons Synthesis – Alkoxy mercuration of alkenes – Reactions of ethers – Acidic cleavage, Claisen rearrangement, Zeisel's method of estimation of methoxy groups – crown ether structure and importance in organic synthesis – Epoxides – Nomenclature – Preparation from alkenes and halohydrins – Reactions – ring opening reactions – acid catalyzed and base catalysed reactions.

Module IV : Aldehydes and Ketones (9hrs)

Nomenclature – Nature of carbonyl group – Preparation – oxidation of alcohols – ozonolysis.

Reactions: Oxidation (with CrO_3, Ag_2O and $KMnO_4$) – Reduction-Wolf Kisner, Clemmenson reduction, metal hydride reduction – Nucleophilic addition (hydration – bisulphite addition, HCN addition).

Hemiacetal and acetal formation – carbonyl – alpha substitution reaction – Keto-enol tautomerism – enolate ion formation – haloform reaction – alkylation of enolate ion – carbonyl condensation reaction – Perkin reaction, clavin schmidth reaction, Stobbe condensation – general mechanism, reaction with hydroxylamine, hydrazine, phenylhydrazine, 2,4 DNP and semi carbazide – study of name reactions with mechanisms – Aldol condensation – Cannizaro reaction – Claisen condensation and benzoin, Beckmann rearrangement – Synthesis of caprolactum – preparation of vanillin and acrolein – distinction between aldehydes and ketones.

Module V : Carboxylic acids and derivatives (9hrs)

Nomenclature – effect of substituent on acidity of aliphatic and aromatic carboxylic acids – Preparation of monocarboxylic acids – oxidative cleavage of alkenes – hydrolysis of nitriles – carboxylation with Grignard reagent – side chain oxidation of alkyl benzenes – reaction of carboxyfic acids – fischer esterification reaction – mechanism of HVZ reaction – decarboxylation – preparation and reactions of acid derivatives – acid chlorides, esters, amides and anhydrides – mechanism of saponification – reaction of cinnamic acid – preparation of Aspirin from salicylic acid – Dicarboxylic acids – Preparation and reactions of malonic acid, adipic acid, phthalic acid – structure of citric acid.

Module VI: Pericyclic Reactions (9hrs)

Features – M.Os of conjugated systems – FMOS – Electrocyclic reaction – Mode of rotations – analysis of odd and even number of electron pair(s) systems with FMO method – cycloaddition reaction – modes of addition – Diels-Alder reaction – Analysis with FMO method – Sigmatropic rearrangement – [1,3] and [1,5] re-arrangements – Cope and Claisen rearrangements – mechanisms. Pericyclic reactions in human body – Vitamin D from cholesterol.

Text Books

1. John McMurry – *Fundamental of Organic Chemistry*. Brook and Cole.
2. Bruice – *Organic Chemistry*, 3rd edition, Pearson Education, New Series 2001.
3. Mark Louden – *Organic Chemistry*, Oxford University Press, Oxford.
4. T.H.Lowry, K.S.Richardson, *Mechanism and Theory in Organic Chemistry*, Harper Colins.

References

1. L.G. Wade, J.R., *Organic Chemistry*, Vth Edn, Pearson Education, Singapore, 2004.

2. Solomons & Fryhle, *Organic Chemistry*, VIIth ed, Wiley India Pvt. Ltd., 2004.

3. I.L. Finar, *Organic Chemistry*, VIth edition, Vol. I & II, ELBS with Longman, Singapore, 1973.

4. Morrison & Boyd, *Organic Chemistry*, VIth ed, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.

5. B.S. Bahl & Arun Bahl, *Adv. Org. Chemistry*., S.Chand & Co New Delhi.

6. Tiwari, Mehrothra, & Vishnoi, *Text book of Organic Chemistry*., Vikas Publishing House Pvt.Ltd, New Delhi.

7. M.K. Jain, *Principles of Organic Chemistry*.

8. S.H.Pine, J.B.Hendrickson, D.J.Cram and G.S.Hammond, *Organic Chemistry*, Mc Graw Hill.

9. C.N.Pillai *Organic Chemistry for Undergraduates*, Universities Press (India) Pvt.Ltd, 2008.

10. Peter.R.S.Murray *Principles of Organic Chemistry* second edition, Ane Books, New Delhi.

SEMESTER V - CORE COURSE VII
PHYSICAL CHEMISTRY – II (72 HOURS)
CREDIT 3 (4 HOURS PER WEEK)

Module I : Solid State (18 hrs)

Law of constancy of interfacial angles – Law of constancy of symmetry – Law of rationality of indices – space lattice and unit cell – Miller indices – seven crystal systems and fourteen Bravais lattices. X ray diffraction – Bragg's equation – Derivation. Brief description of rotating crystal method and powder method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Detailed study of simple, face centred and body centred cubic systems.

Calculation of Avagadro number – Identification of cubic crystal from interplanar distance ratio. Close packing of spheres – packing of spheres in body centred cubic arrangement – Structure of ionic compounds of the type AX (NaCl, CsCl, ZnS), AX_2 (CaF_2,TiO_2).

Defects of crystals. Non stoichiometric and stoichiometric defects. Point defects, Schottky defect and frenkel defects Extrinsic and intrinsic conduction – Liquid crystals classification and its applications (Theory not required).

Module II : Molecular Symmetry and Group Theory (9 hrs)

Elements of symmetry of molecules – Identity – proper axis of rotation, reflection plane, inversion centre, improper axis of rotation – Schonflies notation – Combinations of symmetry operations – Mathematical group – Point conditions – groups of simple molecules – Cnv, Cnh, Dnh. Group multiplication table for C_2v, C_3v and C_{2h}.

Module III : Molecular Spectroscopy (18 hrs)

Interaction of electromagnetic radiation with matter – Energy levels in molecules.

Rotational spectrum – rigid rotator – expression for energy – selection rule — calculation of bond length, moment of inertia.

Vibrational spectra of diatomic molecules – simple harmonic oscillator – selection rule – Vibrational modes of CO_2 and H_2O – calculation of force constant.

Raman spectroscopy: Brief description. Stokes and anti stokes lines and their intensity difference – Rotational Raman spectrum and its selection rules – Mutual exclusion principle.

Electronic spectroscopy : Frank Condon principle – Dissociation energy of diatomic molecule.

NMR spectroscopy: Principle – number of signals, position of signals – chemical shift, intensity of signals, spin-spin coupling, NMR spectra of simple organic molecules.

ESR spectroscopy : Theory – hyperfine splitting of methyl radical.

Module IV : Solutions (9hrs)

Kinds of solutions and methods for expressing concentration – Molarity, molality, mole fraction, normality, mass fraction, parts per million – Ideal solutions – Raoult's law. Solubility of gases in liquids – Henry's law. Pressure – composition and temperature – Composition diagrams – deviation from ideal behaviour for completely miscible liquid systems – Fractional distillation – Colligative properties – Relation between Colligative properties and Molecular mass (Thermodynamic derivation not needed). Abnormal molecular mass – Vant Hoff factor.

Module V : Phase Equilibrium (9hrs)

Phase rule-Equilibrium between phases. Thermodynamic derivation of phase rule – One component systems – Water system and sulphur system – Two component systems – Simple eutectic systems – Lead-silver system, KI-water system – Freezing mixtures. Thermal analysis and desilverisation of lead, solid-liquid equilibria involving congruent and incongruent melting points – Mg-Zn system – $FeCl_3$–H_2O system and Na_2SO_4 water system. Solid Gas equilibrium. Dehydration of copper sulphate pentahydrate. Deliquescence and Eflorescence (mention only). Three component systems – $CHCl_3$-H_2O-HOAc system.

Liquid-liquid-equilibrium – partially miscible and immiscible liquid systems – CST – upper CST and lower CST – Steam distillation – Distribution law and its thermodynamic derivation – Applications.

Module VI : Surface Chemistry & Adsorption (9 hrs)

Physical and chemical adsorption – Adsorption isotherms – Langmuir. Freundlich and B.E.T. equations (B.E.T. no derivation) – Gibbs adsorption equation — Mathematical derivation – Surface films - Determination of surface area using Langmuir and B.E.T. equations.

Colloids: Types and classification – preparation of colloids – purification – protective colloids – kinetic, optical and electrical properties – surfactants – Gels – Emulsions. Properties and applications. Zeta potential, Donnan membrane equilibrium – Dorn effect.

Text books

1) B.R. Puri, L.R. Sharma & M.S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., Jalandhar.

2) P.L. Soni, O.P. Dharmarha & U.N. Dash, *Text book of Physical Chemistry*, 22nd Edn., Sultan Chand & Sons, New Delhi.

3) K.Veera Reddy *Symmetry and spectroscopy of molecules*, New Age International (P) Ltd.

References

1) L.V. Azaroff, *Introduction to Solids*, Mc Graw Hill.

2) N.B. Hanna, *Solid State Chemistry*, Prentice Hall.

3) Colin N. Banwell & E.M. McCash, *Fundamentals of Molecular Spectroscopy*, Tata McGraw Hill Publishing Company Ltd., New Delhi.

4) G.K. Vemula Palli, *Physical Chemistry,* Prentice Hall of India.

5) Gurdeep Raj, *Advanced Physical Chemistry*, Goel Publishing House, Meerut.

6) S. Glasstone & D. Lewis, *Elements of Physical Chemistry*, The McMillan Press Ltd., London.

7) P.W. Atkins, *Physical Chemistry*, 6th Edn, Oxford University Press, Oxford, 1998.

8) G.M. Barrow, *Physical Chemistry*, McGraw Hill, 1992, 5th Edn.

9) W.J. Moore, *Physical Chemistry*, Orient Longmans, 4th Ed.

10) N. Kundu & S.K. Jain, *Physical Chemistry*, S.Chand & Company.

11) P.R. Singh & S.K. Dixit*, Molecular Spectroscopy*, S.Chand & Company.

12) C.N.R. Rao & J. Gopalakrishnan, *New Directions in Solid State Chemistry*, Cambridge University Press, 1997.

13) R. Stephen Berry Stuart A. Rice & John Ross, *Physical Chemistry*, 2nd Ed, Oxford University, Oxford University Press, 2007.

14) R.C. Ropp, *Solid State Chemistry*, Elbs 08.

SEMESTER VI

SEMESTER VI - CORE COURSE VIII
INORGANIC CHEMISTRY – II (54 HOURS)
CREDIT – 3 (3HOURS/WEEK)

Module I: Coordination Chemistry (9 hrs)

Werner's theory – Electronic interpretation of co-ordination compounds - EAN rule – types of ligands – Nomenclature, isomerism – stability of complexes – factors influencing stability – Application of coordination compounds in qualitative and quantitative analysis.

Module II: Theories of bonding in coordination compounds – VBT, CFT and MOT (9 hrs)

VBT – merits and demerits – CFT – crystal field splitting in tetrahedral and octahedral complexes – factors affecting crystal field splitting – CFSE of complexes – spectrochemical series – Explanation of geometry, magnetism and colour on the basis of the above theories.

Module III: Organometallic compounds

Definition – classification based on the nature of metal-carbon bond. Metal carbonyls – 18 electron rule – Mononuclear and polynuclera carbonyls (give examples of Fe, Co, Ni) – Bonding in metal carbonyls – Preparation of carbonyls of Fe and Ni.

Ferrocene – Preparation, properties and structure – Bonding in ferrocene (only qualitative treatment).

Applications of Organometallic compounds – Ziegler-Natta catalyst, Wilkinson catalyst (mechanism not expected).

Module IV: Bioinorganic Chemistry (6 hrs)

Metal ions in biological system – trace and bulk metal ions – Haemoglobin and myoglobin (elementary idea of structure and oxygen binding mechanism). Sodium – potassium pump – biochemistry of Mg, Ca, Zn, Co. Toxicity of metal ion (Pb, Hg, As), Cis-platin as anticancer drug.

Module V: Nano Chemistry (6 hrs)

Introduction – Quantum structures – Nanostructures – synthesis and properties of carbon nano structures – Inorganic nano tubes and nano wires – Oxide nanoparticles – nano composites and nano fibers.

Applications of nano technology in catalysis, biology, nano filters, nano switches.

Image application, writing with atoms – computing and electronics.

Module VI: Inorganic Polymers (6 hrs)

Synthesis, structure and applications of silicones, phosphazenes, S-N compounds, S-P compounds.

Silicates, zeolites.

Module VII: Some industrially important inorganic materials (9 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.Role of selenium in Xerography. Refractory materials – carbides and borides.

Text books

1. Puri, Sharma and Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers and Distributors, 2008.
2. P.L. Soni, *Text book of Inorganic Chemistry*, Sultan Chand and Sons, 2007.
3. W.D.Eingery, H.K.Dowen and R.D.Uhlman '*Introduction to Ceramics'* John Wiley.
4. R.Gopalan and V.Ramalingam '*Concise coordination Chemistry'* Vikas publishing House, New Delhi.
5. J.D. Lee, *Concise Inorganic Chemistry*. 5th Edition, Oxford University Press and Delhi, 2008.

References

1. Cotton and Wilkinson, *Advanced Inorganic Chemistry*, Wiley India Pvt. Ltd., 2008.

2. J.E. Huheey,E.A.Keiter and R.L.Keiter , *Principles structure and reactivity of Inorganic Chemistry*, Derling Kindersley (India) Pvt. Ltd., 2006.

3. D.F Shriver and P.WAtkins, C.H.Langford *Inorganic Chemistry,* ELBS

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

5. Basalo and Johnson, *Coordination Chemistry*, D. Basalo R. Johnson, Benjamin Inc.

6. M.J.Starfield and Shrager, *Introduction to Material Science*, Mc Graw Hill.

7. P. Powell, *Principles of Organometallic compounds*, 2nd Edn, ELBS, 1988.

8. M.W.Barsoum, *Fundamentals of Ceramics*, Mc Graw Hill, 1997.

9. V.S. Muralidharan and A. Subramania, *Nano Science and Technology*.

10. Gurudeep R. Chatwall, *Principles of Inorganic Chemistry*.

11. H.J. Emeleus and Sharpe AG, *Modern Aspects of Inorganic Chemistry*, UBs Publisher's Distributors Ltd., 2000.

12. Wahid U Malik, G.D.Tuli, R.D.Madan *Selected Topics in Inorganic Chemistry* ,S Chand & Co reprint 2009.

13. R.Gopalan *Inorganic Chemistry for undergraduates* Universities Press (India) Pvt Ltd 2009.

SEMESTER VI - CORE COURSE IX
ORGANIC CHEMISTRY III (72 HOURS)
Credit – 3 (4 HOURS/WEEK)

Module I : Structure determination (9hrs)

Chromatographic methods for separation, concentration and characterisation of organic compounds – Column chromatography, Paper, TLC & Gas – Liquid Chromatography.

Application of UV, IR, NMR spectroscopic methods to the structural determination of organic compounds.

UV spectra of butadiene, acetone, vinyl methyl ketone and benzene.

IR spectra of alcohols, aldehydes, ketones & esters.

NMR characteristics of acetone, $CHBr_2CH_2Br$ and ethyl chloride (simple problems may be worked out).

Module II : Amines (9hrs)

Nomenclature – Importance-basic natural products and synthetic compounds – alkaloids, nicotine, piperine, quinine (structure & biological significance only) – Classification – separation of Amines by Hinsberg's method – Nomenclature – Basicity of substituted amines and aryl amines – Preparation – reduction of nitriles, amides and nitro compounds – Azide synthesis – Glabriel phthalmide synthesis – Reactions of amines – Conversion of amine to alkene – Hofman's elimination – Carbylamine reaction – acylation and Benzoylation – diazotisation – Diazonium salts – Preparation of Nylon-6, Nylon-66 step growth polymers.

Module III : Carbohydrates (9hrs)

Classification – representation of monosaccharides – Fischer projection – D, L configuration, Configuration of aldoses – Cyclic structures – Hemiacetal formation – Mutarotation – Preparation and reaction of glucose and fructose– Killiani-Fischer synthesis – Fischers structure proof for glucose. Conversion of aldoses to ketones and vice versa. Disaccharides – Structure of maltose' – Cellobiose, Lactose and Sucrose – Polysaccharides – Cellulose, starch – other sugars, deoxysugar and amino sugar.

Module IV : Amino acids, peptides and proteins (9hrs)

Nomenclature, Classification, isoelectric point, synthesis of amino acids, strcker synthesis, amino malonate synthesis – structure determination of peptide – amino acid analysis – sequencing of peptides – Edmann degradation – Sangers method – Peptide synthesis, solid phase peptide synthesis – Classification of proteins – Primary, secondary and tertiary structure – denaturation of proteins.

Module V : Lipids and Nucleic acids (9hrs)

Lipids – fats and oils – soaps & detergents – phospholipids – steroids – cholesterol – sex hormones – structure and biological functions – Nucleic acids – Nucleotides – bases present in nucleic acids – structure of DNA – Watson-crick model – replication of DNA – structure and biological function of RNA – biosynthesis of protein.

Module VI : Organic Nitro compounds (9hrs)

Nomenclature – preparation of alkyl nitrites, nitroalkanes and nitroarene.

Reduction products of nitrobenzene in acidic, basic and neutral medium. Electrolytic reduction and selective reduction of poly nitro compounds.

Heterocyclic compounds

Nomenclature – structure and application of vitamin B6, ranitidine, fluoro uracil, Trimethoprim, Chloroquin, Preparation, structure and properties of furan, pyrole, pyridine, quinoline, indole. Basicity of piperidine.

Module VII : Active methylene compounds (9hrs)

Synthesis and application of ethyl acetoacetate, diethyl malonate and cyano aceto esters.

Carbonic acid derivatives : Preparation, properties and structure of urea, manufacture of urea and thiourea, preparation and basicity of guanidine.

Dyes: Theory of colour and constituents, classification of dyes, synthesis of methyl orange, malachite green, phenolphthalein alizarin, indigo.

Module VIII : Green chemistry (9hrs)

With the environmental concern and shrinking resources acquiring enormous proportions, it has become imperative to devise safer alternative materials and technology that would ensure the human sustenance. This course intends to take the students through the newer, environment friendly products and procedures and incite them to take a more holistic view of different chemical processes.

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

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

Text Books

1. John McMurry, *Fundamentals of Organic Chemistry*, Vth Edn., Brooks/Cole.
2. Marc Louden, *Organic Chemistry*, Oxford University Press, Calicut.
3. Bruice, *Organic Chemistry*, 3rd Edition, Pearson Education New Series, 2001.
4. V. Kumar, Introduction to Green Chemistry, Vishal Publishing House.

References

1. L.G. Wade, J. *Organic Chemistry*, Vth Edn, Pearson Education, Singapore, 2004.
2. Solomons & Fryhle, *Organic Chemistry*, VIIth ed, Wiley India Pvt. Ltd., 2004.
3. I.L. Finar, *Organic Chemistry*, VIth edition, Vol. I & II, ELBS with Longman, Singapore, 1973.
4. Morrison & Boyd*, Organic Chemistry*, Prentice Hall of India Pvt. Ltd., New Delhi, 1998, VIth ed.
5. B.S Bahl & Arun Bahl, *Advanced Organic Chemistry*., S.Chand & Co, New Delhi.
6. Tiwari, Mehrothra, Vikas & Vishnoi, *Text book of Organic Chemistry*.Vikas Publishing House, Pvt Ltd, New Delhi.
7. M.K. Jain, *Principles of Organic Chemistry*.
8. J.March *Advanced Organic Chemistry* John Wiley and sons.
9. S.H.Pine, J.B.Hendrickson, D.J.Cram and G.S.Hammond *Organic Chemistry*, Mc Graw Hill.
10. C.N.Pillai *Organic Chemistry for undergraduates* Universities Press (India) Pvt Ltd, 2008.

SEMESTER VI - CORE COURSE X
PHYSICAL CHEMISTRY III (54 HRS)
CREDIT 3 (4 HOURS/WEEK)

Module I : Chemical Kinetics (12 hrs)

Rate of reaction and rate equations. Order and molecularity of reactions. Experimental methods of determining reaction rates – Derivation of integrated rate equations for first and second order reactions – General integrated rate equation for n^{th} order reaction. Zero and fractional order reactions. Characteristics of reactions of zero, first, second, third and n^{th} order. Determination of order. Examples of opposing, consecutive and parallel reactions. Qualitative idea of chain reactions. Influence of temperature on reaction rates. Arrhenius equation – Determination and significance of Arrhenius parameters. Collision theory: Derivation of rate equations for bimolecular reaction using collision theory. Collision theory of unimolecular reactions – Lindemann theory – Steady state approximation – Theory of absolute reaction rates – equation and explanation (no derivation).

Catalysis: Homogeneous and heterogeneous catalysis – Intermediate compound formation theory and adsorption theory – kinetics of enzyme catalysis – Michaelis-Menten equation (Derivation not required).

Module II : Photochemistry (6 hours)

Grothus – Draper law, Stark-Einstein law – Beer Lambert's law – Quantum yield. Examples of reactions with high and low quantum yield and explanation. Jablonsky diagram – Fluorescence and phosphorescence – Photosensitisation – Chemiluminescence – Difference between photochemistry and radiation chemistry – Effect of ultrasonic sound and microwave radiation on chemical reactions.

Module III : Electrolytic conductance (12 hours)

Farday's laws – applications – Measurement of conductance – Specific and molar conductance – Arrhenius theory of electrolytic dissociation – Ostwald's dilution law – Variation of conductance with dilution – Debye-Huckel theory and Onsager equation (no derivation) – Debye-Falkenhagen and Wein effect – Ionic mobility and its measurement – Ion conductances – Abnormal conductance of hydrogen and hydroxyl ions. Kohlrausch's law. Transport number and its determination by Hittorf and moving boundary methods – Applications of conductance measurements – Determination of degree of dissociation. Ionic product of water – solubility of sparingly soluble salts – conductometric titrations – Activity and activity coefficients of electrolytes – Ionic strength – Debye-Huckel limiting law – equations only.

Module IV : Ionic Equilibrium (6 hours)

Theories of acids and bases: Arrhenius, Lowry-Bronsted and Lewis theories – Levelling and differentiating solvents – pKa, pKb and pH. Applications of common ion effect and solubility product – Hydrolysis of salts of all types – Degree of hydrolysis and hydrolysis

constant and its relation with k_w. Buffer solutions – Mechanism of buffer action-buffer index – Henderson equation. Theory of acid-base indicators.

Module V : Electromotive Force (12 hours)

Galvanic cells – Reversible cells – Reversible electrodes – Types of reversible electrodes – Reference electrodes – Standard hydrogen electrode, calomel electrode – quinhydrone electrode – standard electrode potential – Electrochemical series – Nernst equation for electrode potential and emf of a cell. Thermodynamics of cell reactions. Application of Gibbs-Helmholtz equation to Galvanic cells – Calculation of ΔG, ΔH and ΔS. Concentration cells – emf of electrode and electrolyte concentration cells with and without transference (general equation) – Liquid junction potential – Applications of emf measurements – determination of pH, solubility of sparingly soluble salt; potentiometric titrations – Redox indicators – Fuel cell (hydrogen-oxygen fuel cell only) – Polarization and over voltage polarography – dropping mercury electrode – significance of half-wave potential and diffusion current – Electrochemical theory of corrosion.

Module VI : Computers in Chemistry (6 hours)

Fundamentals – Introduction to C language, C characters, constants and variables – C statements – conditional statement – simple C programs (1) calculation of molecular mass of organic compounds (2) Calculation of normality, molality and molarity (3) Factorial of a number (4) Determination of half life and average life of radioactive element (5) Determination of pH – Introduction to free and open chemistry softwares available in the internet for drawing structures and molecular viewing.

Text Books

1. Puri, Sharma, Pathania, *Principles of Physical Chemistry*, Vishal Publishing Cogear.
2. P.L Soni & Dharmarha, *Text book of Physical Chemistry*, S.Chand & Co.
3. Gurtu & Snehi, *Physical Chemistry*.
4. Gurdeep Raj, *Advanced Physical Chemistry*, Goel Publishing House.
5. Glasstone & Lewis, *Elementary Physical Chemistry*, Macmillan.
6. Pruton & Maron, *Physical Chemistry*.
7. F. Daniels & R.A. Alberty, *Physical Chemistry*, 5th Edn., Wiley Eastern, 1980.
8. Balaguruswamy, Programming in C.
9. Yesharant Kanetkar, Let us C, BPB Publishers.
10. K.V. Raman, *Computers in Chemistry*. Tata Mc Graw Hill, 1998.
11. I.N.Levin, *Physical Chemistry*.
12. B.S Bahl and Arun Bahl (New Edition), *Physical Chemistry*, S. Chand.

13. Kuriakose and Rajaram – *Thermodynamics,* East-West, 1986.

14. Kundu & Jain, *Physical Chemistry*, S. Chand.

Reference Text books

1. Glastone, *Text book of Physical Chemistry*, Second edition, Macmillan & Co. Ltd., London, 1946.

2. K.L. Kapoor, *Physical Chemistry*,1-5 Volumes, MacMillan.

3. K.J. Laidler, *Chemical Kinetics*, Vol. I and II, Mc Graw Hill.

4. S. Glasstone, *Introduction to Electrochemistry*, Maurie PB Publishers.

5. W.J. Moore, *Basic Physical Chemistry*.

6. Berry, *Physical Chemistry*, 2nd Edn., OUP, 2007.

7. Internet Resources.

8. P.W. Atkins, *Physical Chemistry*, 6th Edn, Oxford University Press, Oxford, 1998.

9. Gilbert W. Castellan, *Physical Chemistry*, 3rd edn, Narosa Publishing House, New Delhi, 2004.

10. Kuriakose & Rajaram, *Dynamics of Chemical Kinetics*.

PRACTICAL CHEMISTRY

UNIVERSITY OF CALICUT
B.Sc PROGRAMME IN CHEMISTRY
Course Structure (Practicals) Credits 24

Sl. No.	Code No	Course Title	Hrs/ week	Semesters	Total Hrs	Credit
1.	CH1B02(P) CH2B04(P) CH3B06(P) CH4B08(P)	Core Course Practical – I	2 Hrs	I,II,III and IV	144	4
2.	CH5B05(P)	Core Course Practical – II	5 Hrs	V	90	4
3.	CH5B06(P)	Core Course Practical – III	5 Hrs	V	90	4
4.	CH6B07(P)	Core Course Practical – IV	5 Hrs	VI	90	4
5.	CH6B08(P)	Core Course Practical – V	5 Hrs	VI	90	4
6.	CH5B14(Pr CH6B21(Pr	Project & Industrial visit	2 Hrs	V, VI	36	
			Total Credits 24			

* All practical examinations will be of 3 Hrs duration. Core course Practical 1 will be held at the end of Fourth semester. Core course Practical II, III, IV, & V will be conducted at the end of sixth semester in two consecutive days (4 sessions of 3Hr duration). Evaluation of project and Viva-voce will also be conducted along with practical exams in sixth semester.

CORE COURSE PRACTICAL - I

SEMESTER (I TO IV): VOLUMETRIC ANALYSIS

CREDIT 4 (2HOURS/WEEK)

Module I: Laboratory safety, first aid and treatment of fires.

Importance of lab safety – burns – eye accidents – cuts – gas poisoning – electric shocks – poisons – treatment of fires – precautions and preventive measures.

Module II: Introduction

Weighing using chemical balance, preparation of standard solutions.

Module III: Acid - base titrations

1. Strong acid – strong base,

2. Strong acid – weak base

3. Weak acid – strong base titrations

4. Estimation of $NaHCO_3$ and Na_2CO_3 in a mixture

5. Estimation of NH_3 by indirect method.

Module IV: Redox titrations

a) Permanganometry – 1. Estimation of oxalate,

2. Estimation of Calcium

3. Estimation of nitrate

4. Estimation of Ferrous iron

b) Dichrometry –

1. Estimation of Fe^{2+} - external and internal indicators.

2. Estimation of Fe^{3+} (after reduction)

c) Iodimetry and Iodometry –

1. standardisation of sodium thiosulphate using potassium iodate, Electrolytic copper and potassium dichromate

2. Estimation of As_2O_3 and arsenite

3. Estimation of copper sulphate.

d) Precipitation titrations – Adsorption indicatos

1. Standardisation of $AgNO_3$

2. Estimation of chloride in neutral medium

e) Complexometric titrations

1. Estimation of Zinc

2. Estimation of Magnesium

3. Estimation of Calcium.

Module V : Some Estimation of practical importance

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 Iodoametric 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

References

1. G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denny '*Vogel's Text book of Quantitative Chemical Analaysis'* 5th Edition ELBS.
2. I.M.Kolthoff and E.A.Sanderson, Quantitative Chemical Analysis
3. O.P. Pandey, D.N Bajpai, S. Gini, *Practical Chemistry*, for I, II & III BSc. Students. S.Chand & Company Ltd reprint 2009.
4. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate *College Practical Chemistry*, Universities Press (India) Pvt Ltd 2008 (reprint)

CORE COURSE PRACTICAL –II
SEMESTER V (INORGANIC QUALITATIVE ANALYSIS)

CREDIT 4 (5 HOURS/WEEK)

Inorganic qualitative Analysis and Preparations

Study of the reactions of the following ions and systematic analysis of mixtures containing two cations and two anions from the list.

Hg^{2+}, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, $As^{3}+$, Fe^{2+}, Fe^{3+}, $Cr^{3+,}$ $Al^{3+,}$ $Mn^{2+,}$ $Zn^{2+,}$ $Ni^{2+,}$ $Co^{2+,}$ Ba^{2+}, $Sr^{2+,}$ $Ca^{2+,}$ $Mg^{2+,}$ and NH_4^{+}

$CO^{2-}{}_3$, SO_4^{2-}, S^{2-}, Cl^{-}, Br^{-}, I^{-}, F^{-}, CH_3COO^{-}, $C_2O_4^{2-}$, PO_4^{3-}, CrO_4^{2-} and NO_3^{-}.

Not more than one interfering ions to be included in a mixture.

Preparation of some Inorganic compounds

Preparation of any four of the following.

1. Ferric alum
2. Potash alum
3. Mohr Salt from Kipp's waste
4. Nickel dimethyl glyoximate
5. Potassium trisoxalato ferrate (III)
6. Tristhioureacopper (I) sulphate
7. Tetraammine copper (II) sulphate

References

1. G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denny '*Vogel's Text book of Quantitative Chemical Analaysis'* 5th Edition ELBS.
2. I.M.Kolthoff and E.A.Sanderson, Quantitative Chemical Analysis
3. O.P. Pandey, D.N Bajpai, S. Gini, *Practical Chemistry*, for I, II & III BSc. Students. S.Chand & Company Ltd reprint 2009.
4. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate *College Practical Chemistry*, Universities Press (India) Pvt Ltd 2008 (reprint)

CORE COURSE PRACTICAL III
SEMESTER V (ORGANIC PRACTICALS)
CREDIT 4 (5HOURS/WEEK)

A. Basic idea on the preparation of reagents used in organic analysis.
(Borshes reagent, Schiff's reagent, phenolphthalein, Neutral $FeCl_3$, Tollens reagent, Fehlings solution)

B. Determination of boiling point and melting point – capillary method

C. Methods of recrystallisation

D. Study of reactions of common functional groups.

E. Analysis of organic compounds containing the following functional groups.

1. Phenols (phenol, α–naphthol, β-naphthol)
2. Nitro compounds (Nitrobenzene, Ortho nitrotoluene)
3. Amines (Aniline, dimethyl aniline)
4. Halogen compounds (Chlorobenzene, Benzylchloride, P-dichloro benene)
5. Aldehydes, ketones (Benzaldehyde, Acetophenone)
6. Carboxylic acid (Benzoic acid, Cinnamic and Phthalic acid, Salicylic acid)
7. Carbohydrates (Glucose, Sucrose)
8. Amides (Benzamides, Urea)
9. Esters (ethyl benzoate, methyl salicylate)
10. Hydrocarbon (Naphthalene Anthracene, Benzene)

G. Organic preparations including recrystallation (Basic concept on Theoretical yield, practical yield, samples % conversion and limiting reagent must be given to the students)

1. Acetanilide to p-nitro cetanilide
2. Acetanilide to p-bromoacetanilide
3. Benzyl chloride to Benzoic acid
4. Nitrobenzene to dinitrobenzene
5. Ester hydrolyis
6. Benzolation (phenol to phenyl benzoate)

Separation Techniques: Thin Layer Chromatography: β naphthol and acetophene one)

Reference:

1. B.S.Furnis, A.J.Hannaford, P.W.G.Smith and T.R.Tatchell *Vogel's Text book of Practical Organic Chemistry* ELBS/Longman 1989.

2. S.P. Bhettani & Aruna Chhikara, *Practical organic chemistry* (qualitative analysis) Ane books (India) Pvt Ltd, 2008.

3. O.P. Pandey, D.N Bajpai, S. Gini, *Practical Chemistry*, for I, II & III BSc. Students. S.Chand & Company Ltd reprint 2009.

4. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate *College Practical Chemistry*, Universities Press (India) Pvt Ltd 2008 (reprint)

5. P.R.Singh, D.C.Gupta, K.S.Bajpal *Experimental Organic Chemistry* Vol.I and II, 1980.

CORE COURSE PRACTICAL – IV

SEMESTER VI (PHYSICAL CHEMISTRY EXPERIMENTS)

CREDIT 4 (5 HRS/WEEK)

Module I: Cryoscopy Using Solid Solvent

a) Cryoscopic constant of solid solvent using a solute of known molecular mass (cooling curve method)
   Solid solvents given: Naphthalene, Biphenyl
   Solutes of known moleculer mass given: 1,4 dichlorobenzene, diphenyl amine, acetanilide, benzophenone etc.
b) Molecular mass of the given solute, using solvent of known Kf.
   Solvents: Naphthalene, Biphul (kf given)
   Solutes: 1,4 dichlorobenzene, diphenyl amine etc.

Module II: Transition Experiments (cooling curve method)

a) Transition point, depression constant (KT) of the given Salthydrate. Using solute of known molecularmass
   salthydrates: $Na_2 S_2 O_3 5H_2o$. $CH_3 COONa3H_2O$. $SrCl_2H_2O$
   Solutes : Urea, Glucose, Sucrose, manitol, sorbitol etc.
b) Molecular mass determination of given solute using salt hydrates of known (KT)
   Salt hydrates and solutes as above

Module III: Phase Rule Experiments

a) **Simple eutectic system**: Construction of phase diagram and determination of eutectic composition and eutectic temperature, systems preferred: Naphthaliee Biphenyl system, Naphthelene diphenyl amine system.

b) **Critical Solution Temperature (C.S.T)**

i) Critical solution temperature of phenol – water system

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

Module IV : Viscometry

a) Viscosity of various liquids using Ostwald's viscometer.

b) Study of glycerine-water system and determination of composition of glycerine water mixture using viscometer. (plot composition against time of flow x density of the solution)

Module V : Solubility Experiments

a) Determination of solubility of the given solute at four different temperature (between 25 to 45^0C)

Solutes: Ammonium oxalate, Oxalic acid.

b) Determination of heat of solution analytically and graphically.

Module VI : Refractometry

a) Determination of composition of glycerine – water mixture by refractice index method.

Conductometry

a) Conductometric titrations

i) Strong acid x strong base

ii) Mixture of acids (strong and weak) x strong base

Module VII : Potentiometry

a) Potentiometric titrations

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

Module VIII : Demonstration Experiments

i) Partition coefficient of I_2 between CCl_4 and H_2O

ii) Chemical Kinetics – Hydrolysis of ester using mineral acids

iii) Calibration of measuring vessels and weights

iv) Preparation of buffer solutions and pH determination by pH paper.

Note:

1. A minimum number of 10 experimental should be done, covering the first eight modules.

2. Electronic balance may be used for practical work.

References

i) Alexander Findlay and J.A. Kitcher. *Practical Physical Chemistry*

ii) Y.B. Yadav, *Practical Physical Chemistry*

iii) O.P. Pandey, D.N. Bahpai S.Giri. *Practical Chemistry for I,II & III B.Sc. Students.*

iv) V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulati *College Practical Chemistry*, Universities Press (India) Pvt Ltd 2008 (reprint).

v) D.P.Shoemaker and C.W.Garland *Experiment Physical Chemistry* Mc Graw Hill.

CORE COURSE PRACTICAL –V
SEMESTER V (GRAVIMETRIC ANALYSIS)

CREDIT 4 (5 HOURS/WEEK)

1. Determination of water of hydration of crystalline barium chloride.
2. Determination of Ba^{2+} as $BaSO_4$
3. Determination of SO_4^{2-} as $BaSO_4$
4. Determination Fe^{3+} as Fe_2O_3
5. Determination Ca^{2+} as $CaCO_3$
6. Determination Ni^{2+} as Nickel dimethyl glyoximate
7. Determination Cu^{2+} as Cuprous thiocyanate
8. Determination Mg^{2+} as Magnesium oxinate

Reference

1. G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denny '*Vogel's Text book of Quantitative Chemical Analaysis'* 5th Edition ELBS.
2. I.M.Kolthoff and E.A.Sanderson, Quantitative Chemical Analysis
3. O.P. Pandey, D.N Bajpai, S. Gini, *Practical Chemistry*, for I, II & III BSc. Students. S.Chand & Company Ltd reprint 2009.
4. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate *College Practical Chemistry*, Universities Press (India) Pvt Ltd 2008 (reprint)

5. CORE COURSE PRACTICAL – OVERALL GRADE

Core Course Practical – I (Volumetric Estimations)

Questions	Grades awarded	Weightage
Procedure writing and weight calculation	A.. . 6 points (1. Correct wt. calculation 2. Correct link solution. 3. Preparation of standard solution.4. Standardisation of link 5. Estimation. 6. Indicates and end points) B.. . . 4 points from the above list C. . . 2 points from the above list D. . . 1 points from the above list E. . . . 0 points from the above list	3
Result of the experiment	A. . . up to 1.5% error B. .. between 1.5 – 2 % error C. . . between 2 – 3% error D. . . between 3 – 6% error E. . .. greater than 6%	10
Calculation of final results	A.. . Correct numerical value B. . . Error in Calculation in 1 step C. . . Error in Calculation in 2 steps D. . . Only correct Equivalent weight E.. . Completely wrong calculation	2

Sample score sheet for : Practical I

No	Questions	Grade awarded	Weightage	Weighted grade point
1	Procedure and weight calculation	A(4)	3	12
2	Result	A(4)	10	40
3	Calculation of final result	B(3)	2	6
Total			15	58

Grade = 58/15 = 3.87 = A Grade

Core Course Practical – II (Inorganic qualitative analysis)

Questions	Grades awarded	Weightage
Identification tests for the 4 ions. (2 cations and 2 anions)	A. . . . 4 Correct identification tests to identify the ions B.. . . Any 3 correct identification tests C. . . Any 2 correct identification tests D. . . Any 1 correct identification tests E. . . . 0 correct identification tests	5
Confirmation tests (4 tests for 4 ions)	A.. . 4 correct tests to confirm 4 ions B. . . 3 correct tests to confirm 3 ions C. . . 2 correct tests to confirm 2 ions D.. . 1 correct tests to confirm 1 ions E. . . Wrong confirmation tests	5
Systematic procedure including elimination of anions	A.. . Correct elimination and systematic procedure B. . .Elimination procedure not complete C. . . Elimination procedure wrong D. . . Elimination procedure not mentioned E. . Wrong elimination and not systematic	1
Chemistry of 4 confirmation tests	A.. . Correct chemistry of 4 confirmation tests B. . . Correct chemistry of 3 confirmation tests C. . . Correct chemistry of 2 confirmation tests D. . . Correct chemistry of 1 confirmation tests E. . Completely wrong	4

Core Course Practical -III (Organic analysis and preparation)

Questions	Grades awarded	Weightage
Method	A. . . . Any 4 Correct points for the preparation B. . . . Any 3 Correct points for the preparation C. . . . Any 2 Correct points for the preparation D. . . . Any 1 Correct points for the preparation E. . . .No Correct points for the preparation	1
Analysis of organic compound	A . . . Correct 5 Points (1. Aliphatic/Aromatic & Saturated/Unsaturated 2. Detection of elements 3. Identification test for functional group 4. Confirmation test for functional group 5. Suggestion of derivative B. . . Correct 4 points C. . . Correct 2 points D. . . Correct 1 point E. . . No Correct point	10
Preparation, Recrystallation, display of derivative	A. . . Correct 4 points (1. organic preparation with good yield. 2. Recrystallation 3. Display of derivative 4. Systematic procedure) B. . . Correct 3 points C. . . Correct 2 points F. . . Correct 1 point D. . . No Correct point	4

Core course practical IV (Physical Chemistry) Kf and Molecular wt determination)

Questions	Grades awarded	Weightage
Method	A. . . . Any 4 Correct points. B. . . . Any 3 Correct points. C. . . . Any 2 Correct points. D. . . . Any 1 Correct points. E. . . .No Correct points.	2
Cooling curve	A . . . 3 correct cooling curve B. . . 2correct cooling curve C. . . 1 correct cooling curve D. . cooling curve with error E. . . No cooling curve	2
K_f/M result	A. . . Results within 10% error B. . . Results within 13% error C. . . Results within 16% error D. . . Results within 20% error E. . . Results greater than 20% error	10
Duplicate	A …. Duplicate conducted within 10% error B … Duplicate conducted within 13% error C …. Duplicate conducted within 16% error D … Duplicate conducted within 20% error E … Duplicate conducted greater than 20% error	1

Core Course Practical – V (Gravimetric Estimation)

Questions	Grades awarded	Weightage
Method for Gravimetric Estimation	A. .. . 4 Points for the gravimetric determination B. .. . 3 Points for the gravimetric determination C . . . 2Points for the gravimetric determination D. . . 1 Point for the gravimetric determination E . . . No correct point	2
Result of Gravimetric estimation	A . . . Upto 1.5% error B. . . Between 1.5- 2.5 % error C. . . Between 2.5- 3.5 % error D. . . Between 3.5- 5 % error E. . . Greater than 5 % error	12
Calculation of final result	A. . . Correct calculation B. . . Error in one step C. . . Error in two steps D. . . Only correct Equivalent. E.. . Wrong Calculation	1

Minimum No.of experiments that the student has to carry out for appearing practical examinations

1. Core course practical I(Volumetric) …….. 15 estimations
2. Core course practical II (Inorganic analysis) …. 8 mixtures
3. Core course practical III (Organic analysis & preparation) .. 10 compounds 8preparations.
4. Core course practical IV (Physical Chemistry) …… 10 experiments
5. Core course practical V (Gravimetry) …… 6 estimations

OPEN COURSE
SYLLABUS

SEMESTER V – OPEN COURSE I

ENVIRONMENTAL CHEMISTRY (54 Hours)

CREDIT 2 (3HOURS/WEEK)

Preamble

Environmental Science in its broadest sense in the science of complex interactions that occur among the terrestrial, atmospheric, aquatic, living and anthropological systems that compose the Earth and the surroundings that may affect living things. It includes all the disciplines, such as Chemistry, Biology, Ecology, Sociology and .....that affect on describe these interactions, ie., the study of earth, air, water, and living environments, and the effect of technology thereon.

As the science of all matter, Chemistry plays a key role in understanding the environment and preserving its quality. In the post grievous damage was done to the environment by misguided and ignorant practices of chemical science. But, or the science of matter, Chemistry plays a key role in environmental protection and improvement. Increasingly, Chemists have become familiar with chemical processes that occur in the environment and have developed means of directing chemical science towards environmental improvement.

Module I: Environment (9hrs)

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.

Module II: Air pollutants (9hrs)

Pollution, origin of pollution, Classification of pollutants – Global, Regional, Local, Persistent and 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.

Module III: Control and monitoring of air pollutants (9hrs)

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.

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, NO_x , SO_x, H_2S, Hydrocarbons and particulate matter.

Module IV: Water pollution (9hrs)

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. 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 V: Industrial waste water treatment (9hrs)

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 VI: Other forms of pollution (9hrs)

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.

SEMESTER V – OPEN COURSE I

CHEMISTRY IN EVERYDAY LIFE – (54 HOURS)
CREDIT 2 (3HOURS/WEEK)

Preamble

Chemistry is a practical art. In our everyday life we come across with 30 many utility materials which all are contributions of Chemistry whether it is food, cloth, drugs, cosmetics and what not. A common knowledge of all the fundamental chemistry behind these utility products will enable us to choose what is essential and discard what are harmful to our life. For example, the cosmetics .These are today, myriads of products in the market, which claims to increase your quality of life and well being. Are they actually as advantageous as they claim? A study of this subject will give you information regarding this. What difference in the cleansing property of toilet soaps - the very costly and moderately priced ones? How the detergents function? What types of unwanted, nonnutritive chemicals are present in the packed food items, the soft drinks and the like that are available in the market? All these useful informations will be obtained if you have the chance to study this particular subject offered as a common course.

Module I: (10hrs)

Functional food additives, adulteration, food laws. Food colours-permitted and nonpermitted – Toxicology. Flavours – natural and synthetic – Toxicology other functional additives. Soft drinks – formulation. Health drinks.

Module II: (10hrs)

Soaps – Introduction, detergent action of soap. Toilet soap, bathing bars, washing soaps, liquid soap manufacture – Batch process, cold process, hot process – semi boiled process, boiled process. Additives, fillers and flavours. Significances of acidity and alkalinity.

Module III: (10 hrs)

Detergents – Introduction, Detergent action, types of detergents – cationic, anionic, amphiphilic detergents. Common detergent chemicals. Additives, excipients colours and flavours. Enzymes used in commercial detergents. Environmental Hazards.

Module IV: (10 hrs)

Cosmetics – Introduction, classification – bathing oils. Face creams, toilet powder, skin products, dental cosmetics, hair dyes, shaving cream, shampoo. General formation for each types. Toxicology of cosmetics.

Module V: (14 hrs)

Plastics in daily use. Polymerization process (brief). Thermosetting and thermoplastic polymers. Use of PET, HDPE, PVC, LDPE, PP, PS, ABS, and others. Recycling of plastics. Biodegradable plastics. Environmental Hazards of plastics. Paper news print, writing paper, paper boards, cardboards. Organic materials, wood, cotton, Jute, coir – International Universal recycling codes and symbols for identification.

References

1. T.P. Coultate, Food – The Chemistry of its components. Royal Society of Chemistry London, (paper back)
2. Shashi Chowls, Engineering Chemistry, Darpat Rai Publication.
3. B.K. Sharma, Industrial Chemistry.
4. CNR Rao, Understanding Chemistry, Universities Press.

SEMESTER V OPEN COURSE I

PLASTICS AND RUBBERS IN EVERYDAY LIFE (54 HOURS)

CREDIT 2(3HOURS/WEEK)

Preamble

Polymer Science and Technology is one of the increasingly important multidisciplinary areas of modern science. An updated and content revision of UG polymer chemistry syllabus is essential to improve its quality at the national and international level and also to meet the present day challenges of PG and research oriented work after the UG programme. The study of polymer chemistry provides supplementary knowledge in making solid background in the traditional areas of chemistry (general, analytical, organic, physical and inorganic). Polymer chemistry touches many scientific disciplines and is vital in fields that develop products typically such as plastics, synthetic fibers; agricultural chemicals, paints adhesives; and biomedical appliances.

There is something unique about studying polymers, macromolecules have a greater complexity than do small molecules. Over the years, our understanding of these large molecules has increased so much that, although they remain complex, we have tools that provide us with a better understanding of their properties, enabling us to make connections between their structure at the molecular level and their properties at the use level.

The revised syllabus takes care of all the above mentioned facts and incorporates most of the important points which cover the fundamentals of polymer chemistry including the classification of polymers, their molecular weight and its determination, structure-property relationships polymer testing and applications.

Module I (10 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, degree of polymerization.

Module II: (8 hrs)

Name, Physical properties and applications of various types of plastics and rubbers: plastics – polyethylene, Polyvinylchloride, polypropylene, nylons, polymethyl methacrylate, polyethylene trephthatalate, Teflon, polystyrene, polycarbonates, rubbers: natural rubber, styrenebutadienerubber, polybutadiene, polyisobutylene, butyl rubber, nitrile rubber, neoprene rubber.

Module III: (8 hrs)

Basic idea of polymers used as adhesive and coatings, liquid crystalline polymers, conducting polymers, biopolymers, biodegradable polymers.

Module IV: (9 hrs)

Polymer for engineering and biomedical applications. Pollution due to polymers, recycling of polymers. Laminates.

Module V: (7 hrs)

Molecular weight – Number average, weight average, viscosity average.

Introduction to tensile, impact, tear, abrasion and flexural properties of polymers.

Module VI: (12 hrs)

General idea of manufacturing of polymer products, basic idea of compounding of rubbers and plastics, some simple moulding techniques: injection moulding, compression moulding and blow moulding. Brief account on polymer industries and opportunities.

References:

1. F.W. Billmeyar, *A text book of polymer science*, John Wiley & Sons, 1971.
2. V.R. Gowariker, N.V. Viswanathan and Sreedhar, *Polymer Science*, Wiley Easern Ltd., New Delhi, 1986.
3. Maurice Morten, *Rubber Technology*, Van Nostrand, Reinold, New York.
4. S. Paul, *Surface Coatings*.
5. B.K. Sharma, *Polymer Chemistry*, Goel Publishing House, Meerut.
6. M. Jenkins, *Biomedical Polymers*, University Birmingham, U.K.

ELECTIVE COURSE
SYLLABUS

SEMESTER VI – ELECTIVE COURSE - (A)

ANALYTICAL CHEMISTRY (54 HOURS)

Preamble

The major objective of this course is to provide a thorough background in those chemical principles that are particularly important to analytical Chemistry. It teaches those laboratory skills that will give students confidence in their ability to obtain high quality analytical data. It allows the students to develop an appreciation for difficult task of judging the accuracy and precision of experimental data and to show how judgements can be sharpened by application of statistical methods. It introduces a wide range of techniques that are useful in modern analytical Chemistry. It helps the students to develop the skills necessary to solve analytical problems in a quantitative manner.

Accordingly, the topics in the syllabus cover both fundamental and practical aspects of chemical analysis.

Module I: General Analytical Principles (18 hrs)

Laboratory hygiene and safety, storage and handling of chemicals, simple first aids – chemicals, acids, alkalies, phenols in eye, burns due to heat, acids, alkalies, bromine, poisoning, inhalation of gases, cut by glass.

Sampling – considerations and techniques for obtaining representative samples of unknown materials for analysis.

Standardization of procedures; calibration of measuring vessels and weights.

Evaluation of analytical data – rounding off, significant figures, accuracy and precision, types of errors, mean deviation and standard deviation, statistical treatment of data, students T test, confidence limit, rejection of suspected values, Q-test, curve fitting – method of average and method of least squares. Types of

titrations – concentratioin terms – molarity, molality, normality, wt. percentage, ppm, millimoles – primary and secondary standards. Preparation of standard solutions – standardisation of solutions – gravimetric analysis principles – buffers – preparation of buffer solutions.

Module II: Separation and Purification Techniques (9 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, sublimation, desiccants, vacuum drying.

Purification of liquids – distillation, vacuum distillation, fractional distillation, steam distillation, azeotropic distillation – principles and techniques.

Chromatographic techniques – LC, GC, HPLC, principles, experimental techniques and applications.

Module III: Optical Methods of Analysis (6 hrs)

Basic theory, instrumentation and typical applications of spectrophotometry, fluorimetry, nephlometry, turbimetry, flame photometry, AAS.

Module IV: Electroanalytical Methods (6 hrs)

Basic theory, instrumentation and applications of electrogravimetry, coulometry, amperometry, cyclic voltametry, polarography, conductometric titrations.

Module V: Thermal- and Radiochemical Methods (6 hrs)

Basic theory, instrumentation and typical applications of TG, DTA and DSC, thermometric titrations.

Radiochemical methods – activation analysis, isotopic dilution techniques.

Module VI: Environmental Chemistry (9 hrs)

Air pollutants, air quality standards, sampling techniques, analysis and monitoring of various inorganic, organic and biological pollutants.

Water pollutants, water quality parameters and standards, determination of BOD, COD and TOC.

Analysis of fat, oils, soaps, sugar and starch, milk, butter, tea, alcoholic beverages, food preservatives, flavourings and colouring agents, adulterants.

Principle of estimation of biological fluids: Hemoglobin, Cholesterol and blood sugar.

Classical and modern methods of drug analysis (vitamin C, codeine, acetyl salicylic acid, phenacetin, sulphanilamide and paracetamol).

References

1. J.G. Dick, *Analytical Chemistry*, Chapter 3.
2. D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouer, *Fundamentals of Analytical Chemistry*, 8th edition.
3. G.D. Christian, *Analytical Chemistry*, 5th edition.
4. D.A. Skoog, D.M. West, *Analytical Chemistry – an Introduction*. 4th Edn, CBS Publishing Japan Ltd., 1986.
5. S.M. Khopkar, *Basic Concepts of Analytical Chemistry*.
6. R. Gopalan, P.S. Subhramanian, K. Rengrajan, *Elements of Analytical Chemistry*.
7. B.K. Sharma, *Instrumental Methods of Chemical Analysis*.
8. A.J. Vogel, *A Text book of Quantitative Inorganic Analysis*.
9. E. Laderer and M. Laderer, *Chromatography*.

10. H.H. Willard, L.L. Merritt and J.A. Dean, *Instrumental Methods of Analysis*.

11. J.J. Lingane, *Electroanlaytical Chemistry*.

12. W.W. Wendlandt, *Thermal Methods of Analysis*.

13. A.K. Dey, *Environmental Chemistry*, 6th Edn., New Age International.

14. R.A.Day and A.L.Underwood, *Quantitative Analysis*, 5th edition, Prentice Hall of India Pvt Ltd, New Delhi.

15. G.L.David Kurupadanam, D.Vijaya Prasad, K.V.Varaprasad Rao, KLN Reddy, C.Sudhakar *Analytical Chemistry*, 2008 (reprint) Universities Press India.

SEMESTER VI – ELECTIVE COURSE (B)

SYNTHETIC ORGANIC CHEMISTRY

Preamble

Chemistry has played, and continues to play, a fundamental role in almost every aspects of modern society. In the field of healthcare, food, shelter, clothes, transport and consumer goods and other utility areas the contribution of synthetic organic chemistry plays central stage. The range of chemical products in today's society make an invaluable contribution to the quality of our lives. For example, in medicine the design and manufacture of pharmaceutical products has enabled us to cure diseases that has ravaged human kind. The contribution of synthetic chemistry is the backbone of pharma industry. Similarly in the area of food processing, an emerging high tech industry, synthetic functional additives plays crucial role. In polymer field synthesis of biometerials, biodegradable polymers that are used for various applications in healthcare support and surgical implants the importance of synthetic organic chemistry is of vital. Hence, the introduction of the elements of synthetic organic Chemistry is very important in the undergraduate level.

Module I: (9 hrs)

Basic concepts of bond breaking and bond making, Review of electronic effects – curved arrow formalism of writing reaction mechanisms.

Reterosynthetic analysis I – Creative chemistry – Synthesis backwards – Synthesis – Choosing a disconnection – Multistep synthesis – Chemoselectivity problems – Functional group interconversions – One and two group disconnections – C-C disconnection – Donor acceptor synthons – 2 group C-O disconnection – 1,5-related functional groups.

Module II: (9hrs)

Organic reagents and their application to organic synthesis – Sodium borohydride, lithium aluminium hydride, disborne N bromosuccinimide, pyridinism chlorochromate, diboro.

Module III: (9hrs)

Synthesis of industrially important organic compounds: (1) Saccharine, (2) Paracetamol (3) Norfloxacin (4) Ramitidine (5) Omeporazole (6) Ibuprofen.

Module IV: (9hrs)

Retrosynthetic analysis and synthesis of natural products.

Terpenes : linonene, citrial, menthol, camphor

Alkaloids : piperine, nicotine, conine, atropine.

Module V: (9hrs)

Brief study of perfumery materials, synthesis of methyl salicylate, jasmone, maltol.

Dyes & intermediates: Diazotization reaction and application. Synthesis of dyes (Synthesis of alizarin, Eosin, indigo, methyl orange)

Module VI: (9hrs)

Asymmetric synthesis: Application of the following strategies in synthesis of one compound each: (a) Chiral pool (b) Chiral auxiliaries (c) Chiral reagents (d) Chiral catalysis Sharpless epoxidation and its application to assymmetric synthesis.

Text Books

1. John McMurry – *Fundamental of Organic Chemistry*. Brook and Cole.
2. Bruice – *Organic Chemistry*, Pearson Education, New Series 2001, 3rd edition.
3. Mark Louden – *Organic Chemistry*, Oxford University Press, Oxford.

4. V.R Gowriker and others '*Polymer Science'* Wiley Eastern Ltd.

5. Saunders *Organic Polymer Chemistry*, Chapman and Hall.

References

1. C.N.Pillai *Organic Chemistry for Undergraduates*, Universities Press (India) Pvt.Ltd, 2008.

2. L.G. Wade, J.R., *Organic Chemistry*, Vth Edn, Pearson Education, Singapore, 2004.

3. Solomons & Fryhle, *Organic Chemistry*, VIIth ed, Wiley India Pvt. Ltd., 2004.

4. I.L. Finar, *Organic Chemistry*, VIth edition, Vol. I & II, ELBS with Longman, Singapore, 1973.

5. Morrison & Boyd, *Organic Chemistry*, VIth ed, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.

6. B.S. Bahl & Arun Bahl, Adv. *Org. Chemistry*., S.Chand & Co.Ltd, New Delhi

7. Tiwari, Mehrothra, Vikas & Vishnoi, *Text book of Organic Chemistry*. Vikas publishing house Pvt.Ltd, New Delhi.

8. M.K. Jain, *Principles of Organic Chemistry.*

9. J.March, *Advanced Organic Chemistry*, John Wiley and sons.

10. T.H Lowry and K.S.Richardson, *Mechanism and Theory in Organic Chemistry,* Harper Collins.

SEMESTER VI - ELECTIVE COURSE (C)

CHEMISTRY AND TECHNOLOGY OF POLYMERS

Module I: (10 hrs)

Basic concepts: An introduction to macromolecules, Concepts of chemical bonding, Classification of polymers – Plastic, (thermoplastics and thermo settings) elastomers, fibres and resins: Natural and synthetic polymers, Engineering plastics Copolyemers, Composites and blends(Elementary idea only)

Molecular weight: Molecular weight distribution, polydispersity index; Number average molecular weight, Weight average molecular weight. Viscoelasticity of polymers (basic concept only).

Module II: (10 hrs)

Methods of polymerisation: Step growth, Chain growth, Ionic polymerization (cationic and anionic) and Ring opening polymerizations including mechanism. Coordination polymerization – concepts of tacticity, Ziegler Natta catalyst (Not detailed mechanism).

Module III: (10 hrs)

Preparation, properties and applications of: vinyl polymers: Polyethylene, PTFE, PVC, Polypropylene, Polystyrene and PMMA. Elastomers: BR, SBR, NBR, CR, IIR, Thiokol, PU and Silicone rubber (no detailed manufacture methods). Structure and composition of natural rubber latex and preparation of RSS.

Module IV: (6 hrs)

Concept of T_g, Crystallinity in polymers, Determination of physical and mechanical properties (density, tensile, tear, abrasion resistance, compression set, resilience, heat build up, stress relaxation, creep).

Module V: (8 hrs)

Rubber processing – Compounding and compounding ingredients, Milling (two-roll mill), Calendaring, Extrusion moulding.

Module VI: (10 hrs)

Plastic processing: Processing aids (no detailed study), Extrusion, Injection moulding, Rotational moulding, Blow moulding, Thermofoarming, Compression moulding, transfer, moulding, Calendaring and Film manufacture.

References

1. Seymour R.B. *Introduction to Polymer Chemistry*, McGraw Hill, New York, 1971.
2. Billmeyar, F.W. *Text book of Polymer Science*, Wiley Interscience, New York, 1971.
3. Gowarikar V.R., Viswanathan N.V., *Polymer Science*, Wiley Eastern Limited, New Delhi, 1986.
4. Paul C. Hiemenz, Polymer Chemistry.
5. Brown R.P., *Physical Chemistry of Rubbers*, Chapman and Hall, London.
6. Morton M., Noushand V. and Reinold, *Handbook of Rubber Technology*, New York.
7. Morton Jones D.H., *Polymer Processing*, Chapman and Hall, London.

SEMESTER – VI ELECTIVE COURSE – (D)
ENVIRONMENTAL CHEMISTRY (54 HOURS)

Preamble

Environmental Science in its broadest sense in the science of complex interactions that occur among the terrestrial, atmospheric, aquatic, living and anthropological systems that compose the Earth and the surroundings that may affect living things. It includes all the disciplines, such as Chemistry, Biology, Ecology, Sociology and .....that affect on describe these interactions, ie., the study of earth, air, water, and living environments, and the effect of technology thereon.

As the science of all matter, Chemistry plays a key role in understanding the environment and preserving its quality. In the post grievous damage was done to the environment by misguided and ignorant practices of chemical science. But, or the science of matter, Chemistry plays a key role in environmental protection and improvement. Increasingly, Chemists have become familiar with chemical processes that occur in the environment and have developed means of directing chemical science towards environmental improvement.

Module I: Environment (9hrs)

Introduction of Environment – components of environment – types of environment segments of environment – biochemical cycles (Carbon cycle, nitrogen cycle, oxygen cycle, phosphorus cycle , sulphur cycle). World conferences on environment. NGOs and environmental awareness. Local environmental movements – Chipco antholan, Silent Valley movement, Plachimada, and other local environmental issues.

Module II: Hydrosphere (27 hrs)

Introduction – characteristics of water – water acidity and CO_2- chemical composition of water in water bodies – (Ground water, river water and lake water, sea water wetlands) – Hydrological cycle- Aquatic pollution – Types of aquatic

pollution – (ground water and surface water pollution due to human activity – pollution due to sewage and domestic wastes – Industrial effluents – Agricultural discharge – Pollution due to soaps and detergents – Marine pollution) – Types of water pollutants – (Biological agents , Chemical agents , Physical agents) – Eutrophication – Water quality parameters (1. DO 2. BOD 3.COD 4. Alkalianity 5. Most probable number 6. Total solids 7. Hardness 8. Chloride, fluoride, sulphate, nitrate) – Toxic metals in water – (1.Aresenic 2.Cadmium 3. Copper 4.Chromium 5.Led 6. Mercury) – Purification of water – Sewage water treatment.

Module III: Atmosphere (12 hrs)

Composition of atmosphere – major regions of atmosphere – Particles Ions and radicals in the atmosphere and their formation (formation of particulate matter, Ions and radicals) – Chemical and photochemical reactions in the atmosphere (Oxygen, Nitrogen, Nitrous oxide, Carbon dioxide, Ozone, Sulphur dioxide)- Air pollution – Major air pollutants – (Oxides of Carbon – Oxides of Nitrogen – Oxides of sulphur- Particulars – Smog and photochemical smog- Metallic pollutants – Radiation – Chemicals – Petroleum – Chlorofluorocarbons) – Effects of Air pollution (Acid rain, Green house effect, Global warming, Depletion of Ozone) – Control of air pollution

Module IV: Solid waste (6 hrs)

House hold, municipal, panchayat and industrial solid waste. Hazardous waste, waste management, solid waste treatment. Nondegradable, degradable and biodegradable waste. Thermal treatment-incinerationsystems, types of incinerators. Biodegradation of waste-anaerobic and aerobic treatment, land treatment and composting.

References

1. A.K.Ahluwalia *Environmental Chemistry* , Ane books India, 2008.

2. B.K. Sharma, H. Kaur, *Environmental Chemistry*, Goel Publishing House, Meerut.

3. S.E. Manahan, *Environmental Chemistry*, CRC Press, London.

4. AK De, *Environmental Chemistry*, 6th Edn. New Age International.

5. P.K. Goel, *Water Pollution*, Causes, Effects and Control, New Age International (P) Ltd.

SEMESTER V ELECTIVE COURSE (E)

INDUSTRIAL CHEMISTRY (54 HRS)

CREDIT 3 (3HRS/WEEK)

Module I - 5 Hrs

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

Fuels , calorific value, Basic concepts of I S O

Module II – 5 Hrs

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 III – 3 Hrs

Inorganic materials of industrial importance –(alumina , clays, mica,) ceramics, Molecular scives, NASICON. Fullerides (Basic concept only).

Adhesives -Type, classification,preparation methods,uses

Module IV - 8 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 – V -5 Hrs.

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 VI -5 Hrs

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

Module VII - 7 Hrs

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

Module VIII – 5 Hrs

Effluent treatment –principles of aerobic and anaerobic effluent treatment – adsorption –filters –sedimentation ,electrostatic methods –wet scrubbers –mist eliminators –brief idea of about waste recycling and its importance, solid waste management

Module IX Dyes -10 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

7. *Industrial effluents* – Manivasakam

8. *Food Chemistry* – B Sreelakshmi

9.*Basic concepts of Analytical chemistry* S H Khopkar

10. *Food chemistry* – L H Meyer

11. *Instrumental methods of analysis* – Williard Merit,dean,settle

12.*A text book of polymer science* – Bill Meyer,

13. *Polymer Science* V R Gowariker,N V Viswanathan,sreedhar

14.*Text Book of Environmental chemistry and Pollution*-S S Dara

COMPLEMENTARY COURSE SYLLABUS

SEMESTER I

GENERAL CHEMISTRY (36 HOURS)

CREDITS 2 (2 HOURS/WEEK)

Module I (9 hours)

Environmental Chemistry

Introduction – Environment and its segments, Ecosystem, Bio, geo, chemical cycles of C, N, P & S.

Hydrochemistry – Hydrological cycles, water resources and aquatic ecosystems – Water quality parameters – DO, BOD, COD– Detection of F^-, Cl^-, SO_4^{2-}, NO_3^-, PO_4^{3-}, acidity and alkalinity of H_2O – pollutants of water, sewage, industrial effluents – soap and detergents, pesticides, fertilizers and heavy metals.Biological magnification and bioaccumulation, Toxic effects of pollutants, Water purification

Air pollution – Major regions of atmosphere, pollution by oxides of N, S, C, hydrocarbons and other organic chemicals, automobile exhausts, their physiological effects on vegetation and living organisms, ozone layer, importance, depletion of ozone, consequence, green house effect, global warming, acid rain,

Noise Pollution and Radiation pollution (brief description only)

Module II (9 hours)

Atomic structure and Chemical Bonding

Bohr atom model, Limitations, De broglie Equation, Heisenberg uncertainty principle, Schodinger equation (mention only), Atomic orbitals, Significance of ψ & ψ^2. Quantum numbers and significance.

Lattice energy of ionic compounds, applications,

VSEPR theory- application to BF_3, CH_4, NH_4^+, PF_5, SF_6, XeF_2, ClF_3 and SF_4. Hybridisation involving s, p, d orbitals – sp (acetylene), sp^2(ethylene), sp^3(methane), dsp^2 $[Ni(CN)_4]^{2-}$, sp^3d (PCl_5), sp^3d^2 (SF_6).

Molecular orbital theory, LCAO - H_2, B_2, C_2, N_2, CO and NO.

Hydrogen bonding in H_2O, organic molecule and biomolecules, intermolecular forces, ion-dipole, dipole-dipole, dipole-induced dipole, induced dipole-induced dipole interactions.

Module III (6 hours)

Bioinorganic Chemistry

Metal ions in biological systems - Biochemistry of iron- Haemoglobin and Myoglobin, Mechanism of O_2, CO_2 transportation, Photosynthesis and respiration, Elementary idea of structure and mechanism of action of sodium potassium pump, Biochemistry of zinc and cobalt.

Module IV (12 hrs)Analytical Chemistry

Accuracy and precision – Classification of errors, calibration of weights and measuring vessels, sampling.

Theory of acids and bases, Bronsted theory, Lewis theory, Lux flood theory, Usanovich theory, Theory of titrimetric analysis – Acid base, Redox and complexometric titrations – Acid-base, Redox and complexometric indicators.

Principles in the separation of cations in qualitative analysis-Applications of common ion effect and solubility product

An outline study of the different types of chromatography- Adsorption, partition and ion exchange chromatography- Column, paper, thin layer and gas chromatography, R_f value – relative merits of different techniques.

References

1. *Environmental Chemistry* - A.K.De
2. *Quantum Chemistry* - R.K.Prasad Revised third edition
3. *Principles of Inorganic Chemistry* - B.R. Puri, L.R. Sharma, K.C. Kalia.
4. *A new concise Inorganic chemistry* – J.D.Lee
5. *University General Chemistry* –CNR Rao
6. Manas Chanda *Atomic structure and chemical bonding*. Tata Mc GrawHill, 2007.
7. Samir K Banerji *Environmental Chemistry* Prentice- Hall of India Pvt Ltd New Delhi – 2007.

SEMESTER II

PHYSICAL CHEMISTRY –I (36 HOURS)

CREDITS 2 (2HOURS/WEEK)

Module I (9 hrs)

Elementary spectroscopy

Regions in Electromagnetic spectrum, different units of energy, Interaction of radiation with matter – different types of energy levels in molecules – rotational, vibrational and electronic levels, width and intensity of spectral lines – A brief discussion of microwave, IR,UV-visible and NMR spectral techniques.

Module II (9 hrs)

Crystalline State

Isotropy and anisotropy, symmetry elements in crystals, The 7 crystal systems – Miller indices, Bravais lattices – Bragg equation, Diffraction of X-rays by crystals: Single crystal method and powder method. Detailed study of the structures of NaCl and KCl crystals – Study of simple cubic, body centred and face centred cubic crystals – Relation between edge length and atomic and ionic radii.

Defects of crystals: Non stoichiometric and stoichiometric defects - Extrinsic and intrinsic defects.

Liquid crystals – mesomorphic state, types of liquid crystals, Swarm theory, Application of liquid crystals, Examples of liquid crystals.

Module III (6 hrs)

Nuclear Chemistry

Nuclear forces, n/p ratio- nuclear stability, Mass Defect, Binding energy, Exchange forces in nucleus, Nuclear structure- liquid drop model, Isotopes, Isobars, Isotones with examples. Detection of isotopes by Astons mass spectrograph, Separation of isotopes by diffusion methods, Nuclear fission, fusion, Application of radio isotopes (radiodiagnosis and therapy, C-14 dating).

Module IV (12 hrs)

Chemical kinetics, catalysis and Photochemistry

Rates of reactions - various factors influencing rate of reactions - Order and molecularity - zero, first, second and third order reactions. Derivation of integrated rate equations (single reactant only), fractional life time, its relation to initial conc. of reactants for various orders, units of rate constants. Influence of temperature on reaction rates, Arrhenius equation, calculation of Arrhenius parameters, Collision theory of reaction rate.

Types of catalysis –homogeneous and heterogeneous, theories of catalysis – outline of intermediate compound formation theory and adsorption theory.

Laws of photochemistry, Grothus Draper law, Stark-Einsten's Law, Beer Lambert's law – photochemical equivalence and quantum explanation for low and high quantum yields. H_2-Cl_2 reaction – photosensitization, Fluorescence, phosphorescence and chemiluminescence.

References

1. *Principles of Physical Chemistry* By Puri ,Sharma &Pathania

2. *A Text Book of Physical chemistry* By A.S.Negi & S.C.Anand

3. *Basic Physical chemistry* – Moore.V.J.

4. L.V.Azaroff *Introduction to Solids* Tata Mc GrawHill

5. P.R.Singh & S.K.Dixit *Molecular Spectroscopy* S.Chand & Company.

6. H.J.Arunikar, *Essentials of Nuclear Chemistry* 4th edition, New age International , New Delhi, 1995.

SEMESTER III

ORGANIC AND BIOCHEMISTRY (54 HOURS)

CREDITS 2 (3HOURS/WEEK)

Module I (6 hrs)

Introduction to Organic Reaction Mechanisms

Nature of bonds, Hybridisation in organic molecules, Homolysis and heterolysis of bonds, Electron displacement in organic compounds – Inductive, Electronic and Mesomeric effects – Influence of Inductive effect on acidic and basic properties of organic compounds. Hyperconjugation and steric effects, Reaction intermediates- carbocation, carbanion, free radicals and carbenes.

Structure and stability of benzene – molecular orbital description – Aromaticity and Huckel's rule, Non benzenoid aromatic compounds, Heterocyclic compounds- Structures of pyrrole, furan, pyran, thiophene, indoles

Module II (9 hrs)

Organic Reaction Mechanisms

Nucleophilic substitution of alkyl halides: S_N1 and S_N2 mechanisms – Stereochemistry- Walden Inversion- Effect of substitution on SN reactions.

Electrophilic addition to ethene and propene – Markownikoff's rule, free radical addition and peroxide effect.

Elimination reactions – E1 and E2 mechanisms – Mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides,

Aromatic Electrophilic substitution – mechanism of nitration, bromination, sulphonation and Friedel Crafts reactions. Orientation effect of substituents

Aromatic nucleophilic substitution.

Module III (3 hrs)

Structure determination

Application of UV, IR, NMR spectroscopic methods to the structural determination of simple organic compounds.

Module IV (9 hrs)

Stereochemistry

Conformation and configuration, Rotation about carbon-carbon single bond, conformations of ethane, cyclohexane, methyl cyclohexane- explanation of more stable conformation.

Geometrical isomerism: explanation taking 2-butene, maleic and fumaric acid as examples

Optical isomerism – Optical activity, Chirality, racemisation and resolution, (Lactic acid and tartaric acid examples) Assymetric synthesis.

Module V (12 hrs)

Amino acids, peptides and Proteins

Amino acids – classification and properties, polypeptides and proteins – peptide linkage, Primary, secondary, tertiary and quaternary structure of proteins, test for proteins.

Nucleic acids, structure of DNA and RNA, Differences, Functions, Different types of RNA, Genetic code, Self replication, mutation.

Enzymes, characteristics, catalytic action, theory of enzyme catalysis- Michaelis Menten theory,

Cellular energetics, thermodynamics of biochemical processes, coupled reactions, ATP, Elementary treatment of the metabolism of carbohydrates, proteins and lipids

Module V (6 hrs)

Polymers

Polymers and polymerization, Types of polymerization, Classification of polymers, Synthetic rubbers (BUNA-S, BUNA N, Neoprene). Synthetic fibres (Nylon 66, Nylon 6, Dacron, Rayon) Plastics- thermoplastics (polythene, polystyrene, polypropylene, PVC, teflon) and thermosetting plastics (bakelite and urea-formaldehyde resin) - Preparation and uses of silicones, Biodegradable plastics.

Moldule VI (9 hrs)

Natural Products

Terpenes: Classification, isoprene rule, essential oils, elementary study of citral & geraniol (structure elucidation not required)

Alkaloids: General methods of isolation, general properties, physiological action of alkaloids, structure of conine, morphine and nicotine (no specific elucidation required). Drugs and psychedelic drugs.

Vitamins, classification, elementary study of the structure of Vitamin A, Biotin, Vitamin C, Vitamin D, Vitamin deficiency diseases.

Hormones: steroids – cholesterol, bile acids, artificial hormones (only elementary study).

References

1. *Modern Organic Chemistry* - M.K. Jain,S.C. Sharma
2. *Text Book of Organic chemistry* –Arun Bahl and Bahl .B.S.
3. *Organic Chemistry*-Vol I and II- I.L.Finar
4. *A guide book to mechanism in organic chemistry*-Peter Sykes
5. C.N.Pillai, *Organic Chemistry for undergraudates*, Universities Press (India) Pvt Ltd, 2008.
6. Tiwari, Mehrothra and Vishnoi , *Text book of Organic Chemistry*, Vikas Publishing house Pvt Ltd, New Delhi.

SEMESTER IV

PHYSICAL CHEMISTRY –II (54 HOURS)

CREDIT 2 (3HOURS/WEEK)

Module I(12 hrs)Thermodynamics

Definition of thermodynamic terms – types of systems – intensive and extensive properties – State and path functions – Zeroth law of thermodynamics.

First law of thermodynamics, mathematical form- concept of internal energy, enthalpy, heat and work, reversible and irreversible process and maximum work. Work of expansion of an ideal gas in reversible isothermal process. Heat capacity of gases at constant volume and constant pressure.

Joule Thomson effect- Application to liquefaction of gases by Linde's method

Second law of thermodynamics – entropy and free energy – significance of ΔH, ΔG and available work. Criteria of equilibrium and spontaneity on the basis of entropy and free energy with conditions of constancy of functions – Gibbs Helmholtz equation and Clausius Clayperon equation.

Enthalpies of formation, combustion, neutralization, solution and hydration - relation between heats of reactions at constant volume and constant pressure. Variation of heats of reaction with temperature – Kirchoff's equation – Hess's law and its application

Module II (12 hrs)Electrochemistry and Electromotive force

Specific, equivalent and molar conductances, determination of conductance and cell constant., variation of conductance with dilution; Kohlrausch's law, degree of ionization of weak electrolytes, application of conductance measurements – conductometric tirations, ostwald's dilution law –hydrolysis of salts, Buffer solutions – Henderson's equation.

Galvanic cells, measurement of emf by Poggendorff's compensation method – Cell and Electrode potentials, IUPAC sign convention – Reference electrodes – SHE and calomel electrode – Standard Electrode Potential, Nernst equation, Cation and Anion reversible electrodes, Redox electrode with examples – Quinhydrone electrode, concentration cell without transference, potentiometric titration, over voltage and passivity. Corrosion of metals – prevention of corrosion, fuel cells – H_2-O_2 and hydrocarbon-O_2 types

Module III (6 hrs) Properties of liquids

Vapour pressure, surface tension, viscosity – explanation of these properties on the basis of intermolecular attraction, refraction, refractive index, molar refraction, molar polarisation.

Module IV (6 hrs) Solutions

Colligative properties- Osmotic Pressure, Laws of osmotic pressure, Measurement of osmotic pressure- Berkeley Hartley's method, Determination of molecular mass, Theories of semipermeability, Reverse osmosis.

Module V (9 hrs)Colloids

Colloidal state, classification, lyophilic & lyophobic, macromolecular, multimolecular, associated colloids – purification of colloids by electrodialysis & ultrafiltration properties – Tyndall effect – Brownian movement, electrophoresis, endo osmosis and sedimentation potential – Donnan membrane equilibrium– origin of charge and stability of colloids, coagulation, Hardy Schulz rule, protective colloids, Gold number – Emulsions – application of colloids – Delta formation, medicines, sewage disposal, emulsification, cleaning action of detergents and soaps.

Module VI(9 hrs)Phase Equilibria

Explanation of terms such as phase, component, degree of freedom. Thermodynamic derivation of phase rule, application of phase rule to one component system – phase diagrams of water and sulphur systems – general discussion of simple eutectic – lead-silver system. Pattinson's process – construction of phase diagram, cooling curve method. General discussion of two component systems forming compound with a congruent melting point. Zn-Mg system.

References

1. *Principles of Physical Chemistry* By Puri ,Sharma &Pathania

2. *A Text Book of Physical chemistry* By A.S.Negi & S.C.Anand

3. *Basic Physical chemistry* – Moore.V.J.

4. R.D.Rastogi, *Introduction to Chemical Thermodynamics*, 6th edition, Vikas Publishing House Pvt Ltd.

5. P.L.Soni & Dharmarh *Text book of Physical Chemistry*, S.Chand & Co New Delhi.

B.Sc COMPLEMENTARY COURSE
SYLLABUS FOR PRACTICALS

Practical I

1. **INORGANIC OUALITATIVE ANALYSIS**

Reactions of cations:-**Group I**: Mercurous, Lead ;

Group II A : Lead,Bismuth,Copper,Cadmium ;

Group II B : Arsenic, Stannous, Stannic ;

Group III : Ferrous,Ferric,Chromium,Aluminium ;

Group IV : Nickel,Cobalt,Mangnese,Zinc ;

Group V : Barium,Strontium,Calcium ;

Group VI : Magnesium, Ammonium.

Reactions of certain anions:- Acetate, Borate,

Oxalate,Phosphate,Arsenste,Arsenite,Chromatte.

Systematic qualitative Analysis for mixture of two cations

Practical II

VOLUMETRIC ANALYSIS

Acidimetry and alkalimetry : Standardisation of hydrochloric acid, Estimation of sodium hydroxide, Estimation of sulphuric acid,Estimatioin of potassium carbonate, Estimation of NaOH and Na_2CO_3 in a mixture,Estimationof barium.

Permanganometry : Standardization of potassium permanganate using standard oxalic acid, Standardization of potassium permanganate using standard Mohr's salt, Estimation of ferrous iron, Estimation of oxalic acid,Estimation of calcium.

Dichrometry : Estimation of ferrous iron using internal indicator,Estimation of ferrous iron using external indicator,Estimation of ferric iron.

Iodimetry and Iodometry : Estimation of iodine,Estimation of potassium permanganate, Estimation of copper,Estimation of potassium dichromate.

Complexometry

Estimation of Zinc, Estimation of Magnesium

Practical III

GRAVIMETRIC ANALYSIS

Determination of water of crystallization in crystalline barium chloride ,Estimation of barium as barium sulphate, Estimation of chloride as silver chloride

Practical IV

DETERMINATION OF PHYSICAL CONSTANTS

Determination of melting point,Determination of boiling point

DETECTION OF ELEMENTS IN ORGANIC COMPOUNDS

ORGANIC PREPARATIONS

Preparation of acetanilide from aniline,preparation of benzoic acid from benzyl chloride, preparation of meta-dinitrobenzene from nitrobenzene.

References

1. G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denny '*Vogel's Text book of Quantitative Chemical Analaysis'* 5th Edition ELBS.
2. I.M.Kolthoff and E.A.Sanderson, Quantitative Chemical Analysis
3. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate *College Practical Chemistry*, Universities Press (India) Pvt Ltd 2008 (reprint)

4. B.S.Furnis, A.J.Hannaford, P.W.G.Smith and T.R.Tatchell *Vogel's Text book of Practical Organic Chemistry* ELBS/Longman 1989.

5. S.P. Bhettani & Aruna Chhikara, *Practical organic chemistry* (qualitative analysis) Ane books (India) Pvt Ltd, 2008.

6. O.P. Pandey, D.N Bajpai, S. Gini, *Practical Chemistry*, for I, II & III BSc. Students. S.Chand & Company Ltd reprint 2009.

7. P.R.Singh, D.C.Gupta, K.S.Bajpal *Experimental Organic Chemistry* Vol.I and II, 1980.

QUESTION PAPER
CORE COURSE I TO X

Core Course – I

FOUNDATIONS IN CHEMISTRY – SEMESTER I

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum weightage: 27***

Section A: Objective Questions

(Answer ALL questions)

Choose the correct answer:

1. i) One of the following is not a discipline of science
   a. Astronomy b. Anthropology
   c. Aerophysics d. Macro Economics
   ii) A hypothesis has ----------
   a. Theoretical evidence b. Experimental evidence
   c. theoretical and experimental evidence d. No theoretical and experimental evidence
   iii) ----- is not a branch of chemistry
   a. physical chemistry b. Organic chemistry
   c. Material science d. Inorganic chemistry
   iv) One of the following is not a unique property of H_2O molecule
   a. high boiling boil b. Hydrogen bonding
   c. Highest density at 4^oC d. Ionic bonding
2. i) Which of the following is not used for measuring electronegativity?
   a. Mulliken's Scale b. Pauling's Scale
   c. Alfred-Roschaw scale d. Slater Scale
   ii) Along the period the electropositivity:
   a. Increases b. Decreases
   c. First Increases and then decreases d. No regular trend
   iii) The electron affinity of chlorine is:
   a. Greater than fluorine b. Less than fluorine
   c. Equal to fluorine d. Lowest in the period
   iv) Which of the following has the greatest IE_2?
   a. Nitrogen b. Oxygen
   c. Fluorine d. Magnesium
3. i) Assuming that the mass of neutron is 1.0087 amu, the density of neutron is
   a. $1.02 \times 10^{+17}$ kg/m^3 b. 1.02×10^{-17} kg/m^3
   c. 1.04×10^{-18} kg/m^3 d. $1.04 \times 10^{+18}$ kg/m^3

ii) The mass of the nucleus of ^{14}C (with $t_{½}$ 5730 years) that is equal to 1 curie is:

a. 1.92×10^{-4} kg
b. $1.92 \times 10^{+4}$ kg
c. 1.72×10^{-4} kg
d. 1.72×10^{4} kg

iii) The most effective projectile is:

a. Proton
b. Neutron
c. Positron
d. Electron

iv) Which of the following is not natural radioactive series?

a. 4n+1
b. 4n+2
c. 4n
d. 4n+3

4. i) The energy of sun is due to:

a. Fission
b. Fusion
c. Fission and fusion
d. Chemical reaction

ii) k-electron capture is:

a. The capture of electron of the l^{st} shell by nucleus
b. The capture of electron of the 1^{st} shell by the 2^{nd} shell
c. Removal of electron from the outer most shell
d. The capture of the k electron by the nucleus of another atom

iii) Neutron was discovered by:

a. Madam Curie
b. Chadwick
c. Rutherford
d. J.J. Thomson

iv) The poor mans Radium is:

a. ^{60}Co
b. ^{226}Ra
c. ^{120}Co
d. ^{14}C

5. i) Lewis acid among the following is:

a. NH_3
b. H_2O
c. BF_3
d. CO_2

ii) The most basic compound among the following is:

a. NH_3
b. PH_3
c. AsH_3
d. SbH_3

iii) The strongest acid among the following is:

a. $HClO_3$
b. $HClO_4$
c. H_2SO_4
d. H_2SO_3

iv) Separation of Isotops can not be carried out using

a. solvent extraction
b. Gaseous diffusion
c. Thermal diffusion
d. Ultra centrifugation

(Weightage: 1 x 5 = 5)

Section B: Short Answer
(Answer any SIX Questions)

6. What are different types of knowledge?
7. State modern periodic law.
8. What is packing fraction?
9. State and explain Geiger- Nuttal rule.
10. What is n/p ratio? How is it related to nuclear stability?
11. What is Catenation
12. What are monomers present in a) Teflon b)PVC
13 Differentiate between metals and metalloids

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. Write the auto ionization of liquid ammonia.
15. Differentiate between ionic, covalent and atomic radii.
16. What are isotopes? How they can be separated by gaseous diffusion method?
17. What is radiocarbon dating? How is it used to detonin the age of fossil?
18. Discuss the reactions taking place in liquid ammonia.
19. What is functional group isomerism. Give an example.

(Weightage: 2 x 4 = 8)

Section D: Essay
(Answer any TWO Questions)

20. Explain the periodicity of ionization potential, electron affinity and electronegativity.
21. a. State and explain slater's rule.
    b. Compare Pauling's scale, Mulliken Scale and Alfred-Rochaw's scale of electronegativity.
22. Discuss the applications of radioactive isotopes.
23. Write notes on
    a) Nuclear fission b) Nuclear fusion
    c) Nuclear stability factors

(Weightage: 4 x 2 = 8)

Core Course – I

FOUNDATIONS IN CHEMISTRY –SEMESTER I

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum weightage: 27***

Section A

(Answer ALL Questions)

Choose the correct answer for each:

1.(i) Laws in science are framed after

A. observations B. evidences

C. proofs D. all the above

(ii) The name 'organic chemistry' was first introduced by the scienstist

A. Scheela B. Raouelle C. Berzelious D. Pauling

(iii) No two electrons in the same atom can have all the quantum numbers identical. This is a statement of:

A. Hund's rule B. Pauli's exclusion

C. Aufbau Principle D. Quantum principle

(iv) Maximum number of electrons that can be accommodated in the M shell is:

A. 2 B. 8 C. 18 D. 36

2.(i) The number of groups present in the long form of the periodic table is:

A. 8 B. 18 C. 6 D. 36

(ii) The most electronegative element after fluorine is:

A. Cl B. Br C. O D. N

(iii) The element which shows diagonal relationship with Li is:

A. Be B. H C. Mg D. Na

(iv) Which of the following has lowest ion radius?

A. Li^+ B. Na^+ C. Mg^{2+} D. Ca^{2+}

3.(i) N^{14} (n, α) ?

A. B^{11} B. F^{19} C. N^{15} D. C^{14}

(ii) Emission of a β particle by a nuclide results in:

A. Increase of mass number B. Decrease of mass number

C. Increase of atomic number D. Decrease of atomic number

(iii) The relationship between λ and $T_{1/2}$ is:

A. $\lambda = \frac{1}{T_{1/2}}$ B. $\lambda = \frac{T_{1/2}}{0.693}$

C. $T_{1/2} = \frac{0.693}{\lambda}$ D. $\lambda = 0.203\ T_{1/2}$

(iv) Which of the following is true?

A) Average life = half life

B) Average life > half life

C) Average life < half life

D) There is no connection with average life and half life

4.(i) C^{14} and N^{14} are a pair of:

A. Isotopes B. Isobars

C. Isotones D. Isomers

(ii) The half life period of C^{14} is approximately:

A. 576 years B. 5760 years

C. 57600 years D. 5×10^5 years

(iii) The isotope used in the treatment of cancer is:

A. Co^{60} B. H^3

C. C^{14} D. N^{15}

(iv) Isotones have same number of:

A. Protons B. Neutrons

C. Both protons and Neutrons D. Nucleons

5.(i) Nuclear stability increases with

A. increase in N/P ratio B. decrease in N/P ratio

C. low binding energy D. low mass defect

(ii) The acidic species present in liquid NH_3 is:

A. NH_2^- B. NH_4^+

C. NH^{2-} D. N^{3-}

(iii) Screening effect will be maximum for

A. s electron B. p electron

C. d electron D. f electron

(iv) Which of the following can act as an acid in H_2SO_4:

A. H_2O B. HNO_3

C. NH_3 D. $HClO_4$

(Weightage: 1 x 5 = 5)

Section B: Short Answer

(Answer any SIX Questions)

6. State group displacement law?
7. Explain nuclear fluid theory?
8. Define electron affinity of an element.
9. What is meant by artificial transmutation?
10. Give one use of isotope as a tracer.

11. Give the self ionization of water molecule.
12. Give an example each for natural polymer and synthetic polymer
13. What is Dacron.

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. State and explain slater's rule.
15. Explain radio active equilibrium?
16. How are the isotopes separated by gaseous diffusion method?
17. Write a note on artificial radioactivity.
18. Water shows maximum density at 4^{o}c. Explain.
19. Give the isomers of compound having molecular formula $C_4H_{10}O$.

(Weightage: 2 x 4 = 8)

Section C: Essay
(Answer any TWO Questions)

20. Bring out the salient features of the long form of the periodic table.
21. Write an essay on the stability of nucleus.
22. State and explain Gieger – Nuttal rule?
23. Bring out the importance of nuclear fission and nuclear fusion in the present energy crisis.

(Weightage: 4 x 2 = 8)

Core Course – III

PHYSICAL CHEMISTRY I – SEMESTER III
MODEL QUESTION PAPER

Time: 3 hrs ***Maximum weightage: 27***

Section A
(Answer ALL Questions)

1. i) For an ideal behaviour, the compressibility factor Z is:

   A. < 0 B. > 0 C. 1 D. Infinity

   ii) At the same temperature and pressure which of the following gases will have the highest kinetic energy per mole:

   A. H_2 B. O_2
   C. CH_4 D. All the above

   iii) The temperature below which the gas does not obey ideal gas law is:

   A. Critical temperature B. Inversion Temperature
   C. Boyle temperature D. Reduced temperature

   iv) The mean free path of a gas is:

   A. Directly proportional to T and P
   B. Inversely proportional to T and P
   C. Directly proportional to P and inversely propositional to T
   D. Directly Proportional to T and inversely proportional to P

2. i) With increase of temperature, the surface tension of a liquid:

   A. Increases B. Decreases
   C. Remains unaffected D. First increases then decreases

   ii) Which of the following properties are intensive?

   A. Volume B. Temperature C. Enthalpy D. Entropy

   iii) The unit of surface tension is:

   A. N/m^2 B. Nm C. N/m D. Nm^2

   iv) Internal energy of a system is:

   A. A state function B. A path function
   C. Both state and path function
   D. Neither state function nor path function

3. i) The product of P and V has the unit of :

   A. Force B. Energy C. Force/area
   D. Dimensionless

   ii) When a reaction is carried out in a closed vessel:

   A. $Q_p < Q_v$ B. $Q_p = Q_v$ C. $Q_p > Q_v$ D. $Q_p = Q_v = 0$

iii) The relation between T and P in an adiabatic process is:

A. TV^{γ} = a constant
B. $TV^{\gamma-1}$ = a constant
C. $VT^{\gamma-1}$ = a constant
D. $T^{\gamma} V^{\gamma-1}$ = a constant

iv) The entropy of mixing of gases is:

A. always –ve
B. always +ve
C. may be +ve or –ve
D. equal to zero

4. i) According to Boltzmann equation:

A. S = k lnw+c
B. S = k lnw
C. K = S lnz
D. S = k lnz

ii) $\left(\frac{\partial G}{\partial P}\right)_T$ is equal to:

A. Volume
B. Internal energy
C. Entropy
D. Free energy

iii) The criteria for reversibility in terms of A is:

A. $(\partial A)_{T,P} \leq 0$
B. $(\partial A)_{T,V} \leq 0$
C. $(\partial A)_{T,P} \geq 0$
D. $(\partial A)_{T,V} \geq 0$

iv) The chemical potential of a constituent in a mixture:

A. Increases with temperature
B. Decreases with temperature
C. First increases and then Decreases with temperature
D. Unaffected by temperature.

5. i) The equilibrium constant for $H_2 + I_2 \rightleftharpoons 2HI$ is K., then the equilibrium constant for $\frac{1}{2} H_2 + \frac{1}{2} I_2 \rightleftharpoons HI$ is

A. K/2
B. 2k
C. $\sqrt{K}$
D. K

ii) Which of the following is a heterogeneous equilibrium?

A. $H_2 + CO_2 \rightleftharpoons H_2O + CO$
B. $2SO_2 + O_2 \rightleftharpoons 2SO_3$
C. $CaCO_3 \rightleftharpoons CaO + CO_2$
D. $CH_3COOC_2H_5 \rightleftharpoons CH_3COOH + C_2H_5OH$

iii) In van der Waal's equation the term which accounts for intermolecular force is

A. RT
B. v-b
C. $P+q/v^2$
D. $(RT)^{-1}$

iv) The value of K_p increases with temperature if

A. $\Delta H = {}^{+}ve$
B. $\Delta H = {}^{-}ve$
C. $\Delta H = O$
D. at constant P

(Weightage: 1 x 5 = 5)

Section B: Short Answer
(Answer any SIX Questions)

6. Define third law of thermodynamics.
7. What is meant by chemical potential?
8. Define surface tension.
9. Calculate the temperature at which O_2 molecule will have the same RMS velocity as CO_2 molecule.
10. Calculate the value of work done when 2g of H_2 expands from a volume of 1 litre to a volume of 10 litres at 27^0C
11. Write Clapeyron-Clausius equation (integrated form) for liquid-vapour equilibrium and explain the terms.
12. Define partition function.
13. What is optical exaltation?

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. Derive an expression for Joule-Thomson coefficient.
15. Derive the relation between temperature and pressure for an adiabatic process.
16. Derive an expression for translational partition function.
17. The equilibrium constant for the reaction $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ is 19.6 at 840^0C and 28.5 at 1035^0C. Calculate the enthalpy change of the reaction.
18. What is Parachor? Can we use it for structure Elucidation.
19. Derive the expressions for critical constants in terms of Vander-Waals constants.

(Weightage: 2 x 4 = 8)

Section D: Essay
(Answer any TWO Questions)

20. Derive the Van't Hoff's reaction Isotherm.
21. Derive Gibb's Helmholtz equation. What is its significance?
22. What is Joule-Thomson effect? Describe Linde's method and Claude's method for the liquifaction of gases.
23. Derive expressions for average, most probable and RMS velocities of a gas using Maxwell distribution of molecular velocities.

(Weightage: 4 x 2 = 8)

PHYSICAL CHEMISTRY I – SEMESTER III
MODEL QUESTION PAPER

Time 3 hrs ***Maximum weightage: 27***

Section A
(Answer ALL Questions)

1. i) A gas would show maximum deviation from ideal behaviour at:

   A. 150^0C, 2 atm B. 0^0C, 2 atm
   C. -100^0C, 2 atm D. -100^0C, 4 atm

   ii) The temperature at which the second virial coefficient of a real gas is zero is called:

   A. Critical temperature B. Boiling point
   C. Boyle temperature D. Inversion temperature

   iii) In van der Waal's equation the term which accounts for intermolecular force is:

   A. RT B. v-b C. $p+q/v^2$ D. $(RT)^{-1}$

   iv) The compressibility factor of a perfect gas is:

   A. Zero B. 1 C. Infinity D. -1

2. i) For an ideal gas μ_{JT} is:

   A. Zero B. Negative C. Positive D. Infinity

   ii) For an adiabatic process

   A. $\Delta P = 0$ B. $\Delta V = 0$ C. $\Delta H = 0$ $\Delta S = 0$

   iii) The maximum efficiency of a steam engine working between 100^oC and 25^oC is:

   A. 20% B. 22.2% C. 25.1% D. 24.8%

   iv) For the reaction the $NH_4HS_{(s)} \rightleftharpoons NH_{3(g)} + H_2S_{(g)}$ equilibrium pressure is 6 atm. Hence K_p for the reaction is:

   A. $3\ atm^{-2}$ B. 6 atm C. $24\ atm^2$ D. $9\ atm^{-2}$

3. i) The change of a liquid into vapour is accompanied by:

   A. evolution of heat B. absorption of heat
   C. decrease in entropy D. no change in entropy

   ii) ..... is a property which is not intensive

   A. Energy B. Surface tension C. Specific heat D. Viscosity

iii) The average kinetic energy of a molecule of an ideal gas is given by:

A. 3/2 RT B. 3/2 KT C. 2 RT D. 3 KT

iv) T_C is given by:

A. $\frac{8a}{27Rb}$ B. $27b^2$ C. 3b D. $\frac{a}{87Rb}$

4. i) For an irreversible process:

A. $\left(\Delta S_{sy} + \Delta S_{sur}\right) = 0$ B. $\Delta S_{sy} = \Delta S_{surr}$

C. $\Delta S_{sys} + \Delta S_{sur} > 0$ D. $\Delta S_{sy} + \Delta S_{sur} < 0$

ii) The equilibrium which is not affected by pressure change at constant T is:

A. $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{(g)}$ B. $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI(g)$

C. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ D. $A_{(g)} + 2B_{(g)} \rightleftharpoons 2AB_{(g)}$

iii) Which of the following is a boson?

A. ^2D B. ^4_2He C. Electron D. ^3T

iv) Translational partition function is given by

A. $\frac{(2\pi mKT)^{3/2}}{h3}.v$ B. $RTlnQ_8$

C. $\frac{8\pi^2 IKT}{\sigma h^2}$ D. $\frac{2\pi mKT}{h^3}$

5. i) The unit of viscosity in SI system is given by:

A. $Kgm^{-2}s^{-1}$ B. Kgm^2s^2 C. $Kgm^{-1}s^{-1}$ D. Kgm^2s^{-1}

ii) A molecule showing deviation from third law of thermodynamics is:

A. N_2 B. Co C. O_2 D. F_2

iii) The expression for chemical potential of a system is given by

A. $\left(\frac{\partial G}{\partial n_i}\right)_{T,P,n_1,n_2\ldots n_{i-1}}$ B. $\left(\frac{\partial H}{\partial n_i}\right)_{T,P,n_1,n_2,\ldots n_{i-1}}$

C. $\left(\frac{\partial A}{\partial n_i}\right)_{T,P,n_1,n_2\ldots n_{i-1}}$ D. $\left(\frac{\partial P}{\partial n_i}\right)_{T,P,n_1,n_2\ldots n_{i-1}}$

iv) Surface tension is related to Parachor by the equation:

A. $[P] = \frac{D}{M\gamma}$ B. $[P] = \frac{M\gamma^{1/4}}{D}$

C. $[P] = \frac{MD^{1/4}}{\gamma}$ D. $M \times D = \gamma^{1/4}$

(Weightage: 1 x 5 = 5)

Section B: Short Answer

(Answer any SIX Questions)

6. Calculate the RMS Velocity of O_2 at 27^oC.

7. Write down an expression for Maxwell distribution of molecular velocities and explain the terms.
8. Write Gibbs Duhem equation and explain the terms.
9. What is fugacity? What is its significance?
10. Calculate the entropy of vapourisation of a liquid which boils at $120^{o}C$. Given enthalpy of vapourisation is 3600 $Jmol^{-1}$.
11. Why chemical equilibrium is termed dynamic?
12. What is statistical weight factor.
13. State and explain the virial equation of state.

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. Derive the relationship between K_p and K_c.
15. Derive Gibbs-Helmholtz equation. What is its significance?
16. Derive the relationship between heat capacity at constant volume and constant pressure for an ideal gas.
17. What is collision frequency? What is the effect of temperature and pressure on collision frequency?
18. Derive Maxwell – Boltzmann distribution law?
19. Derive an expression for the relation between entropy and probability?

(Weightage: 2 x 4 = 8)

Section D: Essay
(Answer any TWO Questions)

20. Derive Clapeyron – Clausius equation for liquid – vapour equilibrium. What is its application?
21. Describe in detail the Carnot reversible cycle for establishing the maximum convertibility of heat into work.
22.a. Discuss the criteria for a spontaneous process in terms of thermodynamic functions.
   b. Two moles of H_2 are compressed adiabatically from STP conditions to occupy a volume of 4.48 litres. Calculate the final temperature (γ for H_2 = 1.41).
23.a. Derive Van der Waal's equation for real gases.
   b. Using critical constants derive reduced equation of state.

(Weightage: 4 x 2 = 8)

Core Course – IV

ORGANIC CHEMISTRY – SEMESTER IV

MODEL QUESTION PAPER I

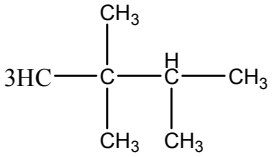
Time: 3 hrs ***Maximum weightage: 27***

Section A

(Answer ALL Questions)

Choose the correct answer:

1.(i) The IUPAC name of



A. 2,2,3-trimethyl butane B. 2,3,3-trimethyl butane

C. 2,3-dimethyl pentane D. 2-methyl hexane

(ii) In Wurtz reaction Alkyl halide reacts with:

A. Benzene to give Benzene homologues

B. Sodium to give higher hydrocarbons

C. Sodium alkoxide to give ethers

D. Moist silver oxide to give alcohols

(iii) Which conformation of butane is more stable?

A. Eclipsed B. Partially eclipsed

C. Staggered D. Gauche

(iv) Number of σ bonds present in ethylene:

A. 5 B. 4 C. 6 D. 7

2.(i) The hybridisation involved in carbocation:

A. sp^2 B. sp^3 C. sp D. sp^3d

(ii) The order of stability of carbanion:

A. $CH_3 > 1^o > 2^o > 3^o$ B. $3^o > 2^o > 1^o > CH_3$

C. $CH_3 > 3^o > 2^o > 1^o$ D. $1^o > CH_3 > 2^o > 3^o$

(iii) Wurtz coupling of 1-bromobutane gives:

A. Octane B. Butane C. Heptane D. Hexane

(iv) The role of $AlCl_3$ in Friedel Craft's reaction is to:

A. Produce nucleophile B. Absorb water

C. Increase the rate of reaction D. Produce electrophile

(v) Gammaxane is obtained when benzene reacts with:

A. $Cl_2/FeCl_3$ B. $HCl/FeCl_3$

C. Cl_2/Fe D. Cl_2/Sunlight

3.(i) An example of Paraffin is:

A. $CH_2 = CH_2$ B. CH_4

C. $CH \equiv CH$ D. $CH_2 = CH\text{-}CH{=}CH_2$

(ii) Oxidation of naphthalene with O_2 in presence of V_2O_5 at 500^oC forms:

A. Benzoic acid B. Naphthaquinone

C. Phthalic acid D. Phthalic anhydride

(iii) Least stable cycloalkane is:

A. Cyclopropane B. Cyclobutane

C. Cyclopentane D. Cyclohexane

(iv) The electrophile involved in Sulphonation of Benzene is:

A. H_2SO_4 B. HSO^+_3 C. SO_3 D. HSO_4^-

4.(i) Oxidation of n-propyl benzene gives:

A. Benzoic acid B. Benzaldehyde

C. 3-phenyl propanoic acid D. 3-phenyl propanal

(ii) The isomer of dichlorobenzene which on nitration forms only one nitro derivative is:

A. *o*-isomer B. *m*-isomer

C. *p*-isomer D. mixture of *o* & *p* isomers

(iii) In the chain form of cyclohexane the maximum non-bonded interaction is between the groups occupying:

A. 1,2 position B. 1,3 position

C. 1,4 position D. Same in all these

(iv) The terpenoid present in oil of lemon grass is:

A. Citral B. Geraniol

C. Nerol D. α-Terpineol

5.(i) In chlorobenzene, chlorine is:

A. Activating and *o-p* directing

B. Activating and *m*-directing

C. Deactivating and *m*-directing

D. Deactivating and *o-p* directing

(ii) *Cis-trans* isomerism is shown by:

A. But-1-ene B. But-2-ene

C. Prop-1-ene D. Isobutene

(iii) Hybridizations involved in allene Carbon atoms are:

A. $sp^3\text{-}sp\text{-}sp^2$ B. $sp^2\text{-}sp\text{-}sp^2$

C. $sp\text{-}sp^2\text{-}sp$ D. $sp^3\text{-}sp^2\text{-}sp$

(iv) 2,2'-dinitro biphenyls are optically active due to:

A. Asymmetric Carbon atom
B. Asymmetric molecule
C. Planarity
D. Axis of symmetry

(Weightage: 1 x 5 = 5)

Section B: Short Answer
(Answer any SIX Questions)

6. What do you mean by the term Aromatic character of organic compounds?
7. What are axial and equitorial bonds in cyclohexane? Give the conformers of cyclohexane.
8. What is hydroboration reaction?
9. Give an example for oxidation with HlO_4.
10. What is the difference between enantiomers and diastereomers?
11. Write an example for *cis*-hydroxylation.
12. What is hyper conjugative effect?
13. Explain Wurtz reaction with an example?

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. What are the postulates of Baeyer's strain theory?
15. Give the industrial application of ethylene and propylene.
16. Describe the Pi bonding in Benzene on the Basis of MO theory.
17. Give any two synthetic routes for preparing cycloalkanes.
18. Explain peroxide effect with an example?
19. Give the mechanism of addition of Br_2 to ethane?

(Weightage: 2 x 4 = 8)

Section D: Essay
(Answer any TWO Questions)

20. (i) Write short note on (a) Hyperconjugative effect (b) Corey-House reaction
    (ii) Huckel's rule and aromatic character.
21. Illustrate the following:
    (i) Optical isomerism of Biphenyls
    (ii) Absolute and relative configuration of organic molecules.
    (iii) Acidity of alkynes.
22. (i) Discuss with suitable example the E,Z system of nomenclature of geometrical isomers.

(ii) Write notes on (a) Asymmetric synthesis (b) Resolution (c) Atropisomerism

23. (i) Discuss the structure of Carbenes and the reasons for their higher activity.

(ii) Give one method of synthesis of naphthalene?

(Weightage: 4 x 2 = 8)

Core Course – IV

ORGANIC CHEMISTRY I – SEMESTER IV

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum weightage: 27***

Section A

(Answer ALL Questions)

Choose the correct answer:

1. i) Cyclohexane at room temperature exist mainly in the:

A. Boat form B. Envelop form

C. Twisted chair form D. Chair form

ii) Which of the following group is *m*-directing when attached to Benzene:

A. $-NH_2$ B. $-NR_2$

C. $-NR^+_3$ D. $-NHR$

iii) $CH_3\text{-}C{\equiv}CH \xrightarrow{H_2O/H_2SO_4/HgSO_4}$?

A. $H_3C-C(=O)-CH_3$ B. $H_3C-C(H_2)-CHO$

C. $H_3C-CH(OH)-CH_3$ D. $H_3C-C(H_2)-C(H_2)-CH_2OH$

iv) Which of the following alkyl halides gives 1-butene on dehydrohalogenation with alcoholic KOH:

A. $CH_3\text{-}CH_2\text{-}CH_2Cl$ B. $CH_3\text{-}CH_2\text{-}CH(Cl)\text{-}CH_3$

C. $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH(Cl)\text{-}CH_3$ D. $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2Cl$

2. i) $CH_3\text{-}CH{=}CH\text{-}CH_3 \xrightarrow{KMnO_4}$

A. $CH_3-CH(OH)-CH(OH)-CH_3$ B. $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_3$

C. $CH_3\text{-}CHO$ D. $CH_3\text{-}CH_2\text{-}CH(OH)\text{-}CH_3$

ii) Which one is more acidic?

A. Chloroacetic acid B. Fluoroacetic acid

C. Nitroacetic acid D. Bromoacetic acid

iii) Which one is more basic?

A. Aniline B. Chloroaniline

C. P-nitroaniline D. P-Bromoaniline

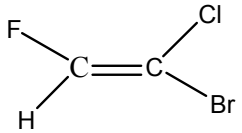
iv) Which one is more stable?

A. Ethyl carbocation
B. Isopropyl carbocation
C. Tertiary Butyl cation
D. Propyl cation

3. i) Citral is a:

A. Acyclic monoterpenoid
B. Monocyclic monoterpenoid
C. Bicyclic monoterpenoid
D. Diterpenoid

ii). Name the following



A. E-1-Bromo-1-chloro-2-fluoro ethane
B. E-2-Brono-2-chloro-1-fluoro ethane
C. Z-1-Bromo-1-chloro-2-fluoroethane
D. Z-2-Bromo-2-chloro-1-fluoroethane

iii) How many stereoisomers are possible in 1,2-dichlorohexane?

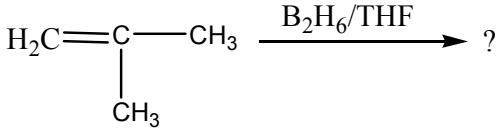
A. Two B. Three C. Four D. Five

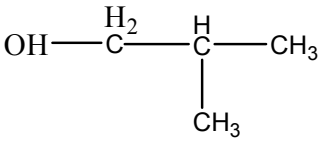
iv) As molecular weight increases Boiling Point:

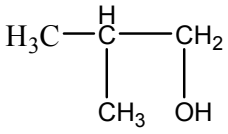
A. Decreases
B. Increases
C. Remains constant
D. Random change

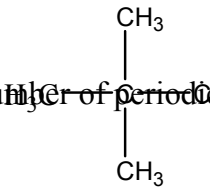
4. i) The major product of the reaction CH_2=CH-CH_3 $\xrightarrow{HCl}$ is:

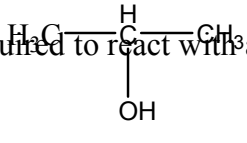
A. CH_3-CH(Cl)-CH_3
B. CH_2(Cl)-CH_2-CH_3
C. CH_2ClCH-CH_3 (Cl)
D. CH_2(Cl)-CH_2-CH_2(Cl)

ii) 

A. 

B. 

C. 

D. 

iii) Number of periodic acid molecule required to react with a molecule of glucose is :

A. 3 B. 4 C. 5 D. 2

iv) Number of asymmetric Carbon atoms in tartaric acid is:

A. 2 B. 3 C. 4

5. i) Which of the following is non-aromatic?

A. Cyclopropenyl carbocation B. Tropylium ion

C. Cyclopentadienyl carbanion D. Cyclobutadiene

ii) Name the product obtained on nitration of p-nitrophenol:

A. 2,4-dinitrophenol B. 3,4-dinitrophenol

C. 2,3-dinitrophenol D. 2,5-dinitrophenol

iii) Mechanism of peroxide effect deals with:

A. Electrophilic addition B. Nucleophilic addition

C. Free radical addition D. None of the above

iv) Example for a nucleophilic addition is:

A. Addition of HBr to ethylene

B. Addition of HBr to propene in presence of peroxide

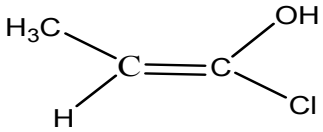
C. Add of HCN to acetaldehyde

D. Addition of Hydrogen to propene

(Weightage: 1 x 5 = 5)

Section B: Short Answer
(Answer any SIX Questions)

6. Explain the isomerism exhibited by maleic acid and Fumaric acid.
7. Give the mechanism of nitration of Benzene.
8. How can you prepare ethyl alcohol from ethylene?
9. Suggest a method for converting a double bond to an epoxide.
10. Distinguish the following compound as E or Z stating reason.



11. Account for the observation that racemic mixture has no optical rotation.
12. Give an example for Corey- House reaction.
13. Give an example of reaction involving nitrene as the intermediate.

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. How do you explain the m-directing property of NO_2 groups in aromatic electrophilic substitution?
15. Illustrate the following terms with an example (a) Enantiomers (b) Diasteromers (c) Explain the optical isomerism in allenes
16. How is naphthalene synthesized?
17. Explain why vinyl halides are much less reactive than alkyl halides in nucleophilic substitution reaction.
18. State and explain Markownikoff's rule with an example?
19. How will you locate the positions of a double bond in olefins?

(Weightage: 2 x 4 = 8)

Section D: Essay

(Answer any TWO Questions)

20. (i) What are the methods available for the resolution of a racemic mixture? Discuss any three.

    (ii) What do you mean by Asymmetric synthesis?

21. (i) Explain with mechanism what is Peroxide effect.

    (ii) Give reasons for the acidity of Acetylene. Compare the acidity of ethylene and acetylene.

22. (i) What are carbocations? Discuss the structure and identify the factors that govern the stability.

    (ii) Give any two examples for polar reactions and radical reactions.

23. (i) How are the following compounds prepared from Naphthalene

    A. Decalin B. 2-Acelyl naphthalene

    C. 1,4-Naphthaquinone D. β-Naphthol

    (ii) Discuss the mechanism of electrophilic substitution in the case of benzene for the following:

    A. Sulphonation B. Halogenation

(Weightage: 4 x 2 = 8)

Core Course – V

INORGANIC CHEMISTRY I– SEMESTER V

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum weightage: 27***

Section A

(Answer ALL Questions)

1.

i Which of the following compounds have the highest lattice energy?

A. NaCl B. MgO C. KCl

D. CaO E. RbCl

ii. According to Fajan, a covalent bond is formed if:

A. Small cation, large anion B. Small anion, large cation

C. Small anion, small cation D. Equal size of cation and anion

iii. The hybridization and shape of I_3^- are:

A. sp^2, linear B. sp^3d, linear C. sp^2, bent

D. sp, linear E. sp^3, bent

iv. Which of the following have a non-zero dipole moment?

A. $BeCl_2$ B. $SnCl_2$ C. CCl_4

D. PCl_5 E. $SnCl_4$

2.

i. Which of the following elements do not impart colour to the flame?

A. Ca and Ba B. Na and Ca

C. Na and Ra D. Li and Mg

ii. The most electropositive element in the periodic table is:

A. Li B. Cs C. Be

D. Ra E. Ca

iii. 3 centre bond is present in:

A. Diborane B. Borazine

C. Boric acid D. Boron nitride

iv. Which of the following does not exist?

A. ICl_3 B. IF_5

C. ClF_3 D. FCl_3

3.

i. Extra pure germanium can be prepared by:

A. Zone refining B. Cupellation C. Poling

D. Puddling E. Mond's process

ii. Open hearth process is used for the manufacture of:

A. Ni B. Ti

C. U D. Steel

E. Li

iii. Which of the following is an alloy of Ni?

A. Alnico B. Siderite

C. Cinnabar D. Magnatite

iv. Orfoed's process is involved in the metallurgy of:

A. Li B. Ni C. Ti

D. U E. Fe

4.

i. Which of the following pairs have identical size?

A. Co^{2+}, Ni^{2+} B. Zr^{4+}, Hf^{4+} C. Sc^{3+}, Y^{3+}

D. Y^{3+}, La^{3+} E. Mn^{2+}, Co^{2+}

ii. Which of the following is diamagnetic?

A. Mn^{2+} B. Co^{2+} C. Zn^{2+}

D. Cu^{2+} E. Ti^{3+}

iii. Which of the following has maximum magnetic moment?

A. Gd^{3+} B. La^{3+} C. Yb^{3+}

D. Lu^{3+} E. Pr^{3+}

iv. The I.E. of d block elements are:

A. Greater than s and p block

B. Greater than s block and lesser than p-block

C. Lesser than s and p block

D. Lesser than s block and greater than p block

E. None is correct

5.

i. Which of the following is a redox indicator?

A. Phenolphthalein B. Methyl orange

C. Diphenyl amine D. Eriochrome black-T

E. Both A and B

ii. Which of the following is not a primary standard substance?

A. $KMnO_4$ B. $H_2C_2O_4.2H_2O$

C. NaOH $5H_2O$ D. H_2SO_4 E. $Na_2S_2O_3.$

iii. On reaction with iodine, $Na_2S_2O_3$ is converted to:

A. Na_2S B. Na_2SO_3 C. Na_2SO_4

D. $Na_2S_4O_6$ E. S

iv. Which of the following has the lowest solubility product?

A. AgCl B. $CuCl_2$ C. $AlCl_3$

D. $CaCl_2$ E. $MgCl_2$

(Weightage: 1 x 5 = 5)

Section B: Short Answer

(Answer any SIX Questions)

6. State and explain Born-Lande equation.
7. Compare the density of alkali metals.
8. Write a note on the electropositive character of I_2.
9. Explain Van-Arkel process.
10. Write the electronic configuration of Nd, Nb and Pa.
11. How is phosphate ion eliminated in inorganic qualitative analysis.
12. What is the composition of German silver?
13. Give 2 indicators used in dichrometry?

(Weightage: 1 x 6 = 6)

Section C: Short Essay

(Answer any FOUR Questions)

14. Differentiate between coprecipitation and post precipitation.
15. Discuss the following properties of transition elements.
    (a) Reducing property (b) Colour
16. Discuss the chemistry of borazine.
17. What is dipole moment? How is it related to molecular structure?
18. Give the structure of ClF_3, IF_5
19. Distinguish between calcination and roasting with examples?

(Weightage: 2 x 4 = 8)

Section D: Essay

(Answer any TWO Questions)

20. Discuss the metallurgy of Titanium.
21. Discuss the General characteristic of Alkali metals.
22. What is Lanthanide contraction? Explain its causes and consequences.
23. Discuss the application of ionic product and solubility product in inorganic qualitative analysis.

(Weightage: 4 x 2 = 8)

INORGANIC CHEMISTRY I– SEMESTER V
MODEL QUESTION PAPER

Time: 3 hrs ***Maximum weightage: 27***

Section A: Objective Questions
Answer ALL Questions.

Choose the correct answer:

1. i) B_2H_6 is an example for:
   A. Electron deficient compound B. Ionic compound
   C. Co-ordination compound D. Non-stoichiometric compound
   ii) General configuration for p-block element can be written as:
   A. $ns^2\,np^n$ B. $ns^2\,np^{n-1}$
   C. $ns^2\,np^{n+1}$ D. $ns^2\,np^{1-6}$
   iii). Which of the following have lowest ionization energy?
   A. Na B. K C. Rb D. Cs
   iv). The hybridization of BCl_3 molecule
   A. sp^3 B. sp C. sp^3d^2 D. sp^2
2. i) Slater's rule is used to calculate:
   A. Energy level of an atomic orbital
   B. Effective nuclear charge
   C. Ionization energy
   D. Electron affinity
   ii) sp^3d^2 hybridization is found in:
   A. XeF_2 B. XeF_4 C. NH_3 D. SO_4^{2-}
   iii) Which of the following have maximum covalent character?
   A. LiCl B. $BeCl_2$ C. BCl_3 D. CCl_4
   iv) Which of the following have zero dipolemoment:
   A. ClF_3 B. BF_3 C. NF_3 D. $CHCl_3$
3. i) Cupellation is used in the refining of:
   A. Silver B. Copper C. Nickel D. Uranium
   ii) Which of the following is a sulphide ore?
   A. Galena B. Siderite C. Rutile D. Lepidolite

iii) Pig iron can be converted to Wrought iron by:

A. Poling B. Puddling C. Bessemerisation

D. Mond's process

iv) Steel is an alloy of iron with:

A. Carbon B. Nickel C. Chromium

D. Aluminium

4. i) Which of the following is a liquid metal?

A. Copper B. Mercury C. Bromine D. Sodium

ii) Which of the following comes under Lanthanide Series?

A. Gadolinium B. Protoactinium

C. Technitium D. Niobium

iii) Which of the following is coloured?

A. Zn^{2+} B. Cd^{2+} C. Sc^{3+} D. Cr^{3+}

iv) Monazite sand is rich in:

A. Sodium B. Vanadium C. Thorium D. Strontium

5. i) Which of the following is least soluble in water?

A. $BaSO_4$ B. $CaSO_4$ C. $MgSO_4$ D. $ZnSO_4$

ii) The oxidation states of Arsenic in Arsenite and Arsenate ion are respectively:

A. +5 & +3 B. +3 & +5 C. -3 & -5 D. -5 & -3

iii) Indicator used in the titration of K_2CO_3 Vs HCl is:

A. Phenolphthalein B. Methyl orange

C. N—phenylanthranilic acid D. Eriochrome Black-T

iv) Which of the following is an adsorption indicator?

A. Eoisin B. Phenolphthalein

` C. Murexide D. N-phenyl anthranilic acid

(Weightage: 1 x 5 = 5)

Section B: Short Answer

(Answer any SIX Questions)

6. State and explain Fajan's rule.
7. Explain inert pair effect with suitable example.
8. What is meant by Gold Schmidt Alumino Thermic Process?
9. Distinguish between diamagnetic and paramagnetic substances taking suitable example.
10. Give the Chemistry of elimination of borate.
11. What is auto catalysis?
12. How is IF_7 prepared?
13. What is gun metal?

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. Give the importance of Ellingham diagram in metallurgy.
15. How solubility of a compound is related to lattice energy give examples.
16. Give the preparation and structure of diborane.
17. Discuss the catalytic property of d-block elements with suitable example.
18. What is dipolemoment? Compare the dipole moment of CO_2 and NO_2.
19.

(Weightage: 2 x 4 = 8)

Section D: Essay
(Answer any TWO Questions)

20. Discuss the metallurgy of Nickel.
21. Explain sp^3, sp^3d, and sp^3d^2 hybridization with suitable examples.
22. Discuss the general characteristics of noble gases. Give the method of separation of noble gases using charcoal.
23. Discuss (A) Adsorption indicators (B) Redox indicators
    (C) Complexometric indicators

(Weightage: 4 x 2 = 8)

ORGANIC CHEMISTRY PAPER – II- SEMESTER V
MODEL QUESTION PAPER

Time: 3 hrs ***Maximum weightage: 27***

Section A: Objective Questions
Answer ALL Questions.

1.

i. Mixture of amino acids can be conveniently separated and identified by the use of:

A. Paper chromatography B. Partition chromatography
C. Adsorption chromatography D. Column chromatography

ii. The separation of resonance frequencies of protons in different structural environments from some chosen standard is known as:

A. Proton resonance B. Chemical shift
C. Spin-spin splitting D. Chemical exchange

iii. How many adsorption peaks will appear in the PMR spectra of CH_3COCH_3?

A. 1 B. 2 C. 4 D. 6

iv. The IR absorption frequency for Ketone is:

A. 3400 cm^{-1} B. 1715 cm^{-1} C. 1050 cm^{-1} D. 1250 cm^{-1}

2.

i. Alkyl halides may be prepared from alcohols by the action of:

A. Phosphorus halides B. Halogen acids
C. Thionyl halides D. All of these

ii. The elimination reactions of primary alkyl halides are generally:

A. S_N1 B. S_N2 C. E1 D. E2

iii. Reaction of vinyl chloride with HCl forms:

A. CH_2 = C.Cl2 B. CH_3-CH_2 Cl
C. Cl-CH=CH.Cl D. CH_3 $CHCl_2$

iv. The role of ether in the preparation of Grignard reagent is to:

A. Stabilize the reagent B. Fasten the reaction
C. Remove unreacted RX D. Dissolve Mg.

3.

i. Frankland reagent is:

A. C_2H_5ZnI B. $C_2H_5ZnC_2H_5$
C. C_2H_5SnI D. $C_2H_5SnC_2H_5$

ii. Sodium salt of benzene sulphuric acid when fused with sodium hydroxide gives:

A. Sodium phenoxide B. Phenol

C. Benzene D. Phenol sulphonic acid

iii. The reaction which may be used to convert phenol to salicylaldehyde:

A. Phthalein reaction B. Reimer Tiemann Reaction

C. Cannizaro reaction D. Liebermann reaction

iv. Phenol forms condensation product with formaldehyde known as:

A. Fluorescein B. P-hydroxy azobenzene

C. Bakelite D. Phenolphthalein

4.

i. In the acid catalyzed cleavage of epoxide ring:

A. More substituted carbon is attacked

B. Less substituted carbon is attacked

C. Either of these can be attacked

D. Reaction does not occur.

ii. Phenyl ethyl ether when boiled with HBr form:

A. Phenol and ethyl bromide B. Phenol and ethane

C. Bromobenzene and ethanol D. Bromobenzene and ethane

iii. Carbonyl compounds may be converted to alkanes by the reaction:

A. Clemmensen's reduction B. Wolf-kishner reduction

C. Both (A) and (B) C. None of these

iv. Oxidation of secondary alcohol to ketone with Aluminium ter-butoxide is known as:

A. Oppenaur oxidation B. Mendius oxidation

C. Stephen's reaction

D. Meerwein-Pondorff-Verley reduction

5.

i. Which of the following will not show haloform reaction?

A. C_6H_5CHO B. CH_3CHO

C. CH_3COCH_3 D. $C_6H_5COCH_3$

ii. Carbonation of Grignard reagent followed by hydrolysis gives:

A. Aldehydes B. Ketones

C. Acids D. None of these

iii. Which of the following is the strongest acid?

A. α-chloropropionic acid B. β-chloropropionic acid

C. γ-chloropropionic acid D. Propionic acid

iv. When Malonic acid is heated with P_2O_5 the product is:

A. Carbon monoxide B. Carbondioxide

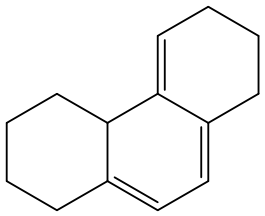
C. Carbonic acid D. Carbon suboxide

(Weightage:1 x 5 = 5)

Section B: Short Answer

(Answer any SIX Questions)

6. What is pinacol-pinacolone rearrangement?
7. Calculate λ_{max} for the following compound



8. Write short note on Reformatsky reaction.
9. What is R_f value?
10. Give an example of nucleophilic aromatic substitution using benzyne intermediate.
11. How is phenolphthalein prepared?
12. What are Frontier Molecular Orbitals?
13. Give one method of preparation of Vinyl chloride?

(Weightage:1 x 6 = 6)

Section C: Short Essay

(Answer any FOUR Questions)

14. Using IR and NMR spectra differentiate between methyl vinyl ether [CH_2=CH-O-CH_3] and allyl alcohol [CH_2 = CH-CH_2OH].
15. Give the mechanism of:

A. Cannizaro Reaction B. Benzoin condensation

16. Describe the structure and importance of crown ethers in organic synthesis.
17. Explain the reactions of alcohols with special reference to dehydration, oxidation and conversion to tosylate.
18. Explain Diels – Alder reaction with FMO method?
19. Explain why arylhalides are less reactive than alkylhalides?

(Weightage : 2 x 4 = 8)

Section D: Essay

(Answer any TWO Questions)

20. What are Grignard Reagents? Give their preparation and synthetic uses.
21. i) Explain S_N1, and S_N2 mechanisms with special reference to the stereochemistry.

ii) Write note of Gas-Liquid chromatography.

22. Discuss the reactions of the carbonyl groups (C=O) with

i) CrO_3
ii) Ag_2O
iii) NH_2OH
iv) KCN and
v) $KHSO_3$

emphasizing the application of each reaction.

23.i) How will you convert cinnamic acid into:

A. Benzaldehyde
B. Styrene
C. Truxinic acid
D. Truxillic acid
E. Glyoxalic acid

ii) Carry out the following conversions:

A. Salicylic acid to Aspirin
B. Adipic acid to Nylon-6,6

(Weightage: 4 x 2 = 8)

ORGANIC CHEMISTRY – II- SEMESTER -V
MODEL QUESTION PAPER

Time : 3 hrs ***Maximum weightage: 27***

Section A
(Answer ALL questions)

Choose the correct answer:

1. i) How many absorption peaks are there in the NMR spectrum of CH_3-CH_2-O-CH_2-CH_3?

   A. 1 B. 2 C. 4 D. 3

   ii) The IR absorption frequency for O-H stretching in alcohol in cm^{-1} is:

   A. 3300 B. 1100 C. 1800 D. 1400

   iii) Reaction of formaldehyde with Grignard reagent will give:

   A. Primary alcohol B. Secondary alcohol
   C. Tertiary alcohol D. Carboxylic acid

   iv) The final product of the reaction $CH_3 - COOH \xrightarrow{Cl_2 / P}$ is:

   A. $ClCH_2COOH$ B. $Cl_2CHCOOH$
   C. Cl_3CCOOH D. CH_3COCl

2. i) Which of the following can be used to distinguish between phenol and carboxylic acid?

   A. NaOH B. $Ca(OH)_2$
   C. $NaHCO_3$ D. Na_2CO_3

   ii) The product of Reimer – Tiemann reaction of phenol is:

   A. Benzoic acid B. Benzaldehyde
   C. Salicylaldehyde D. Nitrophenol

   iii) Which one of the following compounds will give Cannizaro reaction?

   A. CH_3-CHO B. HCHO
   C. CH_3CH_2CHO D. $CH_2{=}CH{-}CHO$

   iv) Which one of the following compounds will give haloform reaction?

   A. CH_3-CHO B. C_6H_5CHO
   C. HCHO D. $C_6H_5COC_6H_5$

3. i) Which of the following compounds do not react with aqueous NaOH?

   A. Allyl Chloride B. Vinyl Chloride
   C. Propyl Chloride D. Benzyl Chloride

   ii) Neopentyl chloride on reaction with alkaline KOH gives:

A. 2-methyl 2-butene B. 3-methyl 1-butene

C. 2,2-dimethyl propene D. No reaction

iii) Identify the compound which gives Ag mirror on reaction with Tollen's reagent:

A. Crotonaldehyde B. Acetone

C. Acetic acid D. Acetyl chloride

iv) Which of the following combination after hydrolysis yield 2-methyl2-butanol?

A. Acetone and Propyl magnesium chloride

B. 2-butanone and methyl magnesium chloride

C. Acetone and ethyl magnesium chloride

D. Both (B) and (C)

4. i) The product obtained by the acid catalyzed hydration of 3-methyl1-butene is:

A. 2-methyl 2-butanol B. 3-methyl 2-butanol

C. Neopentyl alcohol D. n-pentyl alcohol

ii) Chlorobenzene can be converted into phenol by:

A. Grove's process B. Dow's process

C. Raschig's process D. Wacker proces

iii) Acetophenone on Wolf-Kishner reduction gives:

A. Methyl phenyl carbinol B. Ethyl benzene

C. Toluene D. Diphenyl methane

iv) Acetaldehyde and acetone cannot be distinguished by:

A. Tollen's reagent B. Iodoform test

C. Fehling's solution D. Bromine water

5. i) A hydrocarbon with molecular formula C_8H_{10} on oxidation with acidified $KMnO_4$ yield a dicarboxylic acid for which only one mono nitro derivative is obtained. The hydrocarbon is:

A. Ethyl benzene B. ortho xylene C. meta xylene D. para xylene

ii) Identify the final product:

$$\textit{2-butanol} \xrightarrow{Con.H_2SO_4} A \xrightarrow[Zn/H_2O]{O_3} B \xrightarrow[HCl]{Zn/H_2} C$$

A. Ethane B. Propane C. Ethanol D. Acetone

iii) Which of the following carboxylic acids do not give HVZ reaction?

A. propanoic acid B. 2-methyl propanoic acid

C. 2,2-dimethyl propanoic acid D. None of these

iv) Which of the following ethers cannot be prepared by Williamson's synthesis?

A. Diethyl ether B. di-tert-butyl ether

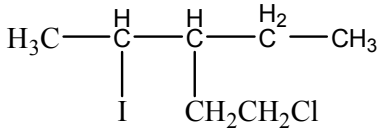
C. Anisole D. dimethyl ether

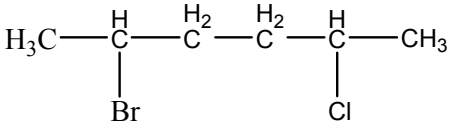
(Weightage: 1 x 5 = 5)

Section B: Short Answer

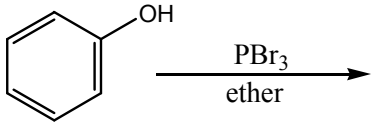
(Answer any SIX Questions)

6. Give the IUPAC names of the following compounds:

i) 

ii) 

7. Predict the products of the following reaction:



8. How will you use IR spectroscopy to distinguish between 1-butyne, 1,3-butadiene and 2-butyne?
9. How many signals would you expect each of the following molecules to have in its ^{1}HNMR spectra?

(i) $(CH_3)_2C=C(CH_3)_2$ (ii) 

10. Arrange the following carboxylic acids in the order of increasing acidity.
    CH_3-COOH, CH_3-CH_2-COOH, Cl-CH_2-COOH, Cl_2CH-COOH
11. Give the structure of citric acid.
12. What is Cope rearrangement? Explain with example?
13. Give the mechanism of HVZ reaction?

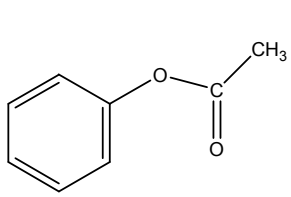
(Weightage:1 x 6 = 6)

Section C: Short Essay Type

(Answer any FOUR Questions)

14. Explain the mechanism of Claisen rearrangement using suitable examples.
15. Explain the synthesis of caprolactum starting from cyclohexanone.
16. Give any two methods for the preparation of monocarboxylic acids.

17. Using NMR and IR spectra how can you distinguish between



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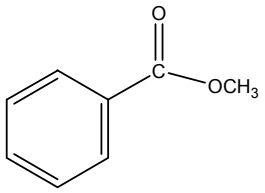


18. Analyse electrocyclic reaction of hexatriene with FMO method?
19. Compare the SN_1 and SN_2 sterochemistry?

(Weightage: 2 x 4 = 8)

Section D: Essay Type
(Answer any TWO questions)

20. Explain various chromatographic methods used for the separation and characterization of organic compounds.
21. Explain the use of organo lithium and organo zinc compounds in the synthesis of organic compounds.
22. Predict the product of each of the following reactions.
    A. CH_2=CH–COOH + H_2/Ni $\rightarrow$
    B. *trans* CH_3–CH=CH-COOH + Br_2/CCl_4 $\rightarrow$
    C. C_6H_5-CH(OH)CH_2-COOH + H^+ $\xrightarrow{heat}$
    D. $HOOCCH_2CH_2COOH + LiAlH_4 \rightarrow$
23. Explain use of Williamson's synthesis and alkoxy mercuration of alkenes for the preparation of ethers.

(Weightage: 4 x 2 = 8)

Core Course – VII

PHYSICAL CHEMISTRY II – SEMESTER V
MODEL QUESTION PAPER

Time: 3 hrs ***Maximum weightage: 27***

I. Multiple choice – 20 questions (Bunches of 4 questions)

Weightage: 1 x 5 = 5

II. Short answers – Six questions

Weightage: 1 x 6 = 6

III. Short essays – Four questions

Weightage: 2 x 4 = 8

IV. Long essays – Four questions (Answer any two)

Weightage: 4 x 2 = 8

Total = 27

Core Course – VII

PHYSICAL CHEMISTRY II - SEMESTER V

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum weightage: 27***

Section A

(Answer ALL Questions)

1. i. H_2O molecule belongs to which point group?

A. C_{3V} B. C_{2V}

C. D_{2h} D. D_{2d}

ii. Which will not change with temperature?

A. Molarity B. Molality

C. Normality D. None

iii. For a one component system maximum number of phases that can co-exist at equilibrium is:

A. 2 B. 1 C. 3 D. 4

iv. CH_3CHO & CS_2 is an example for a solution showing:

A. $^{+}$ve deviation from Raoult's law

B. $^{-}$ve deviation from Raoult's law

C. No deviation

D. None

2. i. Which of the following point group will have a centre of inversion (i)?

A. C_{2V} B. D_{2h} C. D_{3h} D. $D_{\alpha h}$

ii. Which of the following ion has the highest coagulating power?

A. Mg^{+2} B. Al^{+3} C. Na^{+} D. K^{+}

iii. Conversion of a precipitate to colloidal state is called:

A. Coagulation B. precipitation C. peptisation D. None

iv. Example for a system with incongruent melting point:

A. H_2O B. Sulphur C. Pb-Ag D. $FeCl_3$-H_2O

3. i. Smoke is an example for a colloidal system:

A. Solid in gas B. Gas in Solid

C. Liquid in gas D. Gas in liquid

ii. Eutectic point in a system corresponds to:

A. Highest M.P B. Highest B.P

C. Lowest M.P D. Lowest B.P.

iii. Number of particles per unit cell of FCC:

A. 1 B. 2 C. 3 D. 4

iv. Bragg's equation is given by the equation:

A. $n\lambda = 2\theta \sin\theta$ B. $n\lambda = 2d \sin\theta$

C. $2n\lambda = 2d \sin\theta$ D. $n\frac{\theta}{2} = \frac{d}{2}\sin\lambda$

4. i. The structure of CsCl crystal is:

A. Body centred cubic lattice

B. Face centered cubic lattice

C. Octahedral

D. None

ii. Maximum close packing is in the crystal:

A. Simple cubic B. Face centered cubic

C. Body centered cubic D. None

iii. The difference in successive lines in wave number in rotational spectra is given by:

A. B B. 2B C. B/2 D. 3B

iv. Which of the following molecule will give rotational spectra?

A. H_2 B. HCl C. BF_3 D. None

5. i. What can be deduced from vibrational spectroscopy?

A. Bond distance B. Force constant

C. Reduced mass D. Atomic mass

ii. Which of the following nuclei will show nuclear magnetic resonance?

A. ^{12}C B. ^{16}O

C. ^{1}H D. All of above

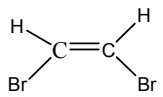
iii. Which of the following compound will give two singlets in their NMR spectra?

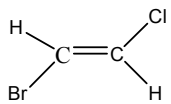
A. CH_3COOCH_3 B. $CH_3\text{-}CH_2Cl$

C. $CH_2\text{-}Cl\text{-}CH_2\text{-}Cl$ D. $CH_3\text{-}CH_2\text{-}COO\text{-}CH_3$

iv. Which of the following molecule will not show spin-spin splitting in NMR spectra?

A. $Cl\text{-}CH_2\text{-}CH_2\text{-}I$

B. 

C. 

D. $CH_3\text{-}CHO$

(Weightage: 1 x 5 = 5)

Section B: Short Answer

(Answer any SIX Questions)

6. Why Eutectic mixture is not considered as a true chemical compound?
7. What are micelles?
8. What you mean by gold number of a sol? what is its significance?
9. Draw group multiplication table of C_{2V} point group.
10. What type of molecules gives rotational Raman Spectra?
11. What is radius ratio? How does coordination number vary with the radius ratio?
12. What is meant by Dorn Effect?
13. Explain the term chemical shift?

(Weightage: 1 x 6 = 6)

Section C: Short Essay

(Answer any FOUR Questions)

14. Give methods for purification of colloids.
15. Write a note on fractional distillation.
16. Explain how rotational spectroscopy can be used to find the bond length.
17. Write a note on non-stoichiometric defects.
18. Describe the powder method of X-ray diffraction of solids.
19. What are the application of liquid crystals.

(Weightage: 2 x 4 = 8)

Section D: Long Essay

(Answer any TWO Questions)

20. Draw phase diagram of Sulphur system. Explain it.
21. Analyze the powder diffraction pattern of NaCl. Compare with that of KCl.
22. Explain with suitable examples, the vapour pressure-composition and boiling point(temperature)-composition curves for solutions which are ideal, showing positive and negative deviations from ideal behaviour.
23. a) Derive an expression for energy of a rigid rotator.

    b) The pure rotational spectrum of gaseous HCl consists of a series of equally spaced lines separated by 20.80 cm^{-1}. Calculate the internuclear distance (bond length) of HCl. (The atomic mass of Hydrogen = 1.008 and that of Chlorine = 35.5 g/mol)

(Weightage: 4 x 2 = 8)

Core Course – VII

PHYSICAL CHEMISTRY II – SEMESTER V

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A

(Answer ALL Questions)

1. i) Of the following species which is ESR active?

   A. Sodium atom B. Hydrogen molecule

   C. Cu^+ ion D. Diamond

   ii) The vibrational mode of carbondioxide (CO_2) molecule is:

   A. 6 B. 5 C. 3 D. 4

   iii) The basic requirement for a molecule to be micro wave active is the presence of:

   A. Permanent dipole moment B. Non polarity

   C. Polarisability D. None of the above

   iv) The selection rule for rotational Raman spectra is:

   A. $\Delta J = \pm 1$ B. $\Delta J = \pm 2$

   C. $\Delta J = 0$ D. All the above

2. i) The zero point energy of a molecule undergoing simple harmonic oscillation is:

   A. $\epsilon_o = \frac{3}{2}\bar{\omega}_{osc}$ B. $\epsilon_o = \frac{1}{2}\bar{\omega}_{osc}$

   C. $\epsilon_o = \bar{\omega}_{osc}$ D. $\epsilon_o = \frac{5}{2}\bar{\omega}_{osc}$

   ii) A molecule with point group having inversion centre is:

   A. C_{2v} B. C_{3v} C. C_{2h} D. C_{3h}

   iii) A symmetry operation exhibited by all molecules is:

   A. σ_v B. C_n C. i D. E

   iv) The point group of benzene molecule is:

   A. C_{2v} B. D_{6h} C. C_{6h} D. C_{4v}

3. i) The interplanar spacing between (220) planes in a cubic unit cell with edge length 2 pm:

   A. 1 pm B. 2 pm C. 3 pm D. 4 pm

ii) The unit cell dimensions of a crystal is $a = b \neq c$, $\alpha = \beta = \gamma = 90$, identify the crystal system:

A. Monoclinic B. Orthorhombic

C. tetragonal D. Triclinic

iii) The molecular formula of a compound existing in F.C.C. system, with A type particles at the corners and B type particles at the centres of faces:

A. AB B. AB_3 C. A_2B_6 D. A_8B_6

iv) The number of Bravais lattices belonging to the crystal system orthorhombic:

A. 1 B. 2 C. 3 D. 4

4. i) Co-ordination ratio of Zn^{2+} ions and S^{2-} ions in ZnS(Zinc blende) crystal is:

A. 4:4 B. 8:8 C. 6:6 F. 4:8

ii) The function of a surfactant is to:

A. Increase the viscosity

B. Increase the interfacial tension

C. Decrease the viscosity

D. Decrease the interfacial tension

iii) During positive adsorption:

A. The surface tension of the solution decreases

B. The surface tension of the solution increases

C. The surface area of the adsorbant increases

D. None of the above

iv) The value of Van't Hoff factor of potassium ferrocyanide $K_4[Fe(CN)_6]$ in H_2O is (assuming complete dissociation):

A. 4 B. 5 C. 3 D. 1

5. i) The freezing point of 0.1 M aqueous solution of glucose (cryoscopic contant of water = 1.86):.

A. 0^oC B. -1^oC C. -1.86^oC D. -0.186^oC

ii) The number of degrees of freedom at eutectic point for simple eutectic system:

A. Zero B. One C. Two D. Three

iii) How many stable triple points are there for sulphur system?

A. One B. Two C. Three D. Four

iv) An example of a system showing only lower critical solution temperature (C.S.T) is:

A. Phenol-water B. Nicotine-Water system

C. Aniline-hexane system D. Triethyl amine-water system

(Weightage: 1 x 5 = 5)

Section B: Short Answers

(Answer any SIX Questions)

6. What is the closure rule of a mathematical group?
7. Draw the planes with Miller indices (200) and (101) in a cubic lattice.
8. State mutual exclusion principle with one example.
9. What are azeotropes? Explain.
10. What are deliquescent and efflorescent substances?
11. What is the difference between physical adsorption and chemical adsorption?
12. Explain the term Zeta potential
13. What is Frank – Condon principle?

(Weightage: 1 x 6 = 6)

Section C: Short essays

(Answer any FOUR Questions)

14. Construct the group multiplication table for C_{2v} point group.
15. Tungsten (Atomic weight 184) forms body centered cubic crystal, its density is 19.3 g/cm^3. Calculate the edge length of the unit cell. (Avagadro number = 6.02 x 10^{23})
16. What is chemical shift? Discuss the high resolution NMR spectra of acetaldehyde (CH_3CHO).
17. a. What are condensed systems and explain the reduced phase rule equation.
    b. Draw and explain the phase diagram of Zn-Mg system.
18. Explain the intensity differences of stokes and antistokes lines?
19. Explain the different classes of liquid crystals.

(Weightage: 2 x 4 = 8)

Section D: Long Essays

(Answer any TWO Questions)

20. What is hyperfine splitting in ESR spectra? Explain using methyl radical as an example.
21. a) Derive Bragg's equation for the diffraction of X-rays by crystals.
    b) State distribution law and derive it thermodynamically.
22. a) Derive phase rule using thermodynamic approach.
    b) What is steam distillation? What are its main applications?
23. Derive Langmuir adsorption isotherm. How it is used to determine the surface area of adsorbants?

(Weightage : 4 x 2 = 8)

INORGANIC CHEMISTRY II - SEMESTER VI
MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A: Objective Questions
(Answer ALL Questions)

Choose the correct answer:

1. i) The EAN of iron in potassium ferricyanide is:

A. 4 B. 6 C. 35 D. 36

ii) Which of the following is an ambident ligand?

A. Ethylene diamine B. Thiocyanate
C. Pyridine D. Oxalate

iii) The oxidation number of vanadium in $K[V(CO)_6]$ is:

A. 1 B. 0 C. +1 D. 2

iv) Which is not a ligand?

A. PH_3 B. CH_3OCH_3 C. CCl_4 D. NH_2NH_2

2.i) An example for a polydentate ligand is:

A. Pyridine B. EDTA C. CO D. OH^-

ii) The relationship between Δ_o and Δ_t is:

A. $\Delta_o = \Delta_t$ B. $\Delta_t = \frac{9}{4}\Delta_o$

C. $\Delta_t > \Delta_o$ D. $\Delta_t = \frac{4}{9}\Delta_o$

iii) Which of the following is an example for coordination isomerism?

A. $K_3[Fe(CN)_6$ and $K_4[Fe(CN)_6]$
B. $Pt[NH_3Cl_2]$ and $[Pt(NH_3)_4]$ $[PrCl_4]$
C. $[Co(NH_3)_6]$ $[CrCl_6]$ and $[Cr(NH_3)_6]$ $[CoCl_6]$
D. $[Cr(NH_3)_5$ SCN] and $[Cr(NH_3)_5NCS]$

iv) The number of geometrical isomers possible for an octahedral complex of the type MA_3B_3 is:

A. 1 B. 2 C. 3 D. 4

3.i) Which of the following is not an organometallic compound?

A. $K_2[PtCl_3C_2H_4]$ B. $Fe_3(CO)_{12}$
C. CH_3CH_2OK D. CH_3MgBr

ii) Zeigler-Natta catalyst is used in:

A. Hydrogenation reactions B. Polymerization reactions
C. Oxidation reactions D. Elimination reactions

iii) Which of the following carbonyls does not obey the 18 electron rule?

A. $Ni(CO)_4$ B. $Mn_2(CO)_{10}$

C. $V(CO)_6$ D. $Fe_3(CO)_{12}$

iv) The C-O bond order in Ni $(CO)_4$ is:

A. 3 B. less than 3 C. More than 3 D. 4

4.i) The oxidation state of Fe in haemoglobin and oxyhaemoglobin is respectively:

A. 2 and 3 B. 2 and 2 C. 3 and 3 D. 1 and 2

ii) The amino acid moiety connected to Fe in haemoglobin is:

A. Glutamic acid B. Valine

C. Tryptophan D. Histidine

iii) The metallic part present in Vitamin B_{12} is:

A. Fe B. Co C. Ni D. Cu

iv) Carboxypeptidase is an enzyme containing:

A. Fe B. Co C. Zn D. Cu

5.i) Pb is an essential constituent of:

A. Soda glass B. Clint glass

C. Bottle glass D. Fibre glass

ii) Blue colour is imparted to glass by mixing with:

A. Fe_2O_3 B. Cr_2O_3 C. CoO D. MnO

iii) A super conducting polymer is

A. $(SN)_x$ B. P_4S_4 C. $(NPCl_2)_n$ D. $(SiOR_2)_n$

iv) A compound which is not coloured

a) $Zn(OH)_2$ b)$Cu(OH)_2$ c) $Ni(OH)_2$ d) $Fe(OH)_2$

(Weightage : 1x 5 = 5)

Section B: Short Answer
(Answer any SIX Questions)

6. Explain Hydrate isomerism with an example.
7. Give the IUPAC names of

   A. $K_3[CoF_6]$ and B. $[Co(NH_3)_5 Br] Cl_2$
8. What is Wilkinson's catalyst? Give its application.
9. Draw the Structure of S_4N_4.
10. Define glass transition temperature of a polymer.
11. Give any two applications of Phosphorous based polymers.

12. What is a nano tube?
13. Give two important uses of ceramics.

(Weightage : 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. Explain the term 'spectrochemical series'.
15. Bring out the role of Se in xerography.
16. What is annealing of glass? What is its significance?
17. How are different types of silicones prepared? Give any two applications of silicones.
18. What is EAN, Calculate EAN of Co in $(CoCl_4)^{2-}$
19. Give two examples each for nitrogeneous and phosphatic fertilizers.

(Weightage : 2 x 4 = 8)

Section D: Essay
(Answer any TWO Questions)

20. Bring out the salient features of the valance bond theory of bonding in coordination compounds. What are the main merits and demerits of VBT?
21. How is ferrocene prepared? Explain the nature of bonding in ferrocene. Why is its aromatic?
22. Explain the role of haemoglobin and myoglobin in oxygen transport and storage in human body.
23. Write an essay on the applications of nano materials.

(Weightage : 4 x 2 = 8)

Core Course – VIII

INORGANIC CHEMISTRY II – SEMESTER VI

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A: Objective Questions

(Answer All Questions)

Choose the correct answer:

1. i) When $K_2Cr_2O_7$ is heated with conc. HCl the reduction product is:

A. $CrCl_3$ B. Cl_2 C. KCl D. H_2O

ii) $Ni(CO)_4$ is:

A. Square planar and paramagnetic

B. tetrahedral and diamagnetic

C. Square planar and diamagnetic

D. Tetrahedral and Paramagnetic

iii) The magnitude of Δ_O value will depend on:

A. Charge of the central metal ion

B. Nature of the ligand

C. Principal quantum number of the d-electron

D. All the above

iv) Baeyer's reagent is:

A. Neutral solution of $KMnO_4$

B. Dilute alkaline solution of $KMnO_4$

C. Dilute acidic solution of $KMnO_4$

D. None of these

2. i) The IUPAC name of the complex $K_4[Fe(CN)_6]$ is:

A. Potassium hexacyanoferrate (II)

B. Potassium hexacyanoferrate (IV)

C. Prussian blue

D. None of the above

ii) The effective atomic number of Fe in $K_3[Fe(CN)_6]$ is:

A. 36 B. 35

C. 37 D. None of the above

iii) Which type of square planar complexes show geometrical isomerism?

A. Ma_4 B. Ma_3b C. Ma_2b_2 D. Mab_3

iv) Wilkinson's catalyst is used in the:

A. Polymerization of alkenes
B. Hydrogenation of alkenes
C. Oxidation of alkenes
D. Hydration of alkenes

3. i) Ferrocene is an example of:

A. Tetrahedral complex
B. Octahedral complex
C. Sandwitched complex
D. Square planar complex

ii) Vitamin B_{12} is a complex of:

A. Mg
B. Ca
C. Zn
D. None of the above

iii) Which of the following is not a sigma bonded complex?

A. Grignard reagent
B. Tetraethyl lead
C. Dibenzene chromium
D. Dimethyl zinc

iv) For which of the following d^n configuration can octahedral complexes exist in both high spin and low spin forms?

A. d^1
B. d^3
C. d^4
D. None of the above

4. i) Choose a species which cannot act as a ligand:

A. CO B. CO_2 C. H_2O D. NH_3

ii) Refractory materials are used for the construction of furnaces because they:

A. are very hard
B. are leak proof
C. can withstand high temperature
D. are light in weight

iii) Pick out the odd reagent:

A. $KMnO_4$
B. $K_2Cr_2O_7$
C. V_2O_5
D. $LiAlH_4$

iv) Iron has lowest oxidation state in:

A. $FeCl_3$
B. $FeSO_4$
C. $Fe(CO)_5$
D. $K_4[Fe(CN)_6]$

5. i) What is the coordination number of Co in $[Co(NH_3)_5 (NO_2)] Cl_2$?

A. 2 B. 3 C. 5 D. 6

ii) The CFSE of an octahedral complex with d^3 configuration is:

A. $0.4 \Delta_o$ B. $1.8 \Delta_o$ C. $1.2 \Delta_o$
D. None of the above

iii) EDTA is a:

A. Bidentate ligand
B. Pentadentate ligand
C. Tetradentate ligand
D. None of the above

iv) The hybridization of Ni in the complex $Na_2[Ni(CN)_4]$ is:

A. sp^3 B. sp^2 C. dsp^2 D. d^2sp^3

(Weightage : 1 x 5 = 5)

Section B: Short Answer

(Answer any SIX Questions)

6. Explain why $K_2[PtCl_6]$ does not give white precipitate of AgCl with $AgNO_3$
7. Explain why tetrahedral complexes are unable to exhibit geometrical isomerism.
8. Most of the coordination complexes are coloured. Why?
9. What are the materials used for the manufacture of cement?
10. What is meant by quantum size effect?
11. What are nanotubes?
12. What is Zeigler – Nutta Catalyst?
13. Give 2 examples for trace metals in biological systems.

(Weightage: 1 x 6 = 6)

Section C: Short Essay

(Answer any FOUR Questions)

14. How organometallic compounds can be classified based on the nature of metal-carbon bond?
15. Explain the factors influencing the stability of complexes.
16. Write a note on different types of glasses and their uses.
17. Write a note on thermal, magnetic and electronic properties of nano particles.
18. Draw the structure of $Fe_2(CO)9$, $Fe_3(CO)_{12}$
19. Explain spectro chemical series.

(Weightage: 2 x 4 = 8)

Section D: Essay

(Answer any TWO Questions)

20. Explain the bonding in octahedral complexes with sigma bonds only, using MO theory.
21. What are the different types of isomerism exhibited by co-ordination complexes? Explain.
22. Write notes on:
    A. Phosphonitrilic compounds
    B. Polymeric sulphur nitride
23. How ferrocene can be prepared? Explain its structure and bonding.

(Weightage : 4 x 2 = 8)

Core Course – IX

ORGANIC CHEMISTRY III - SEMESTER VI

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A

(Answer ALL questions)

Choose the correct answer:

1. i) Primary amines on reaction with nitrous acid give:

   A. Carboxylic acid B. Alcohol

   C. Nitro compound D. Aldehyde

   ii) Carbylamine reaction is used for the confirmation of:

   A. 2^oamine B. 3^o amine

   C. 1^oamine D. Quaternary ammonium salts

   iii) The specific rotation of glucose changes with time. This phenomenon is called:

   A. Isomerism B. epimerism

   C. tautomerism D. mutarotation

   iv) Denaturation of proteins causes to destroy its:

   A. 1^o structure B. 2^o structure

   C. 3^o structure D. none of these

2. i) Among the following which is the basic amino acid:

   A. Glycine B. Alanine

   C. Lysine D. Valine

   ii) Ketohexose found in fruits is:

   A. Lactose B. Fructose

   C. Glucose D. Galactose

   iii) Choose the correct molecular formula of nicotine:

   A. $C_{10}H_5N_2O_2$ B. $C_{10}H_{14}N_2$

   C. $C_{10}H_6N$ D. $C_{10}H_{12}NO$

   iv) Name the molecular rearrangement taking place when cyclohexane oxime is converted into caprolactum:

   A. Beckmann B. Claisen

   C. Pinacol-pinacolone D. Hoffmann

3. i) Lactose on hydrolysis using dilute acids gives:

   A. Glucose and galactose B. Glucose and Fructose

   C. Galactose and fructose D. Sucrose and fructose

ii) A nucleotide contains:

A. Base and Sugar
B. Base and phosphate group
C. Base sugar and phosphate group
D. Sugar and phosphate group

iii) A mixture of acetylene and HCN when passed through a red hot tube gives:

A. benzene
B. pyridine
C. Cyclohexane
D. Phenol

iv) Urea on heating at 150^{o}C gives:

A. CO_2
B. H_2O
C. NH_3
D. Biuret

4. i) A steroid nucleus consist of fused carbon rings of:

A. 3 hexagon and 1 pentagon
B. 1 hexagon and 3 pentagon
C. 2 hexagon and 3 pentagon
D. 2 hexagon and 2 pentagon

ii) Example for a triphenyl methane dye is:

A. Phenolphthalein
B. Malachite green
C. Alizarin
D. Methyl organe

iii) 'A' is a compound containing active methylene group. Its molecular formula is $C_6H_{10}O_3$. Identify the compound:

A. Cyanoacetic ester
B. Acetoacetic ester
C. Dimethyl malonate
D. Acetic anhydride

iv) Nitrobenzene on treatment with steam in the presence of Fe metal gives:

A. Aniline
B. Nitrosobenzene
C. Nitrosoamine
D. Phenol

5. i) Purine bases present in RNA are:

A. Adenine, Uracil, Cytosine
B. Adenine, Guanine, Cytosine
C. Uracil, Guanine, Cytosine
D. Adenine, Thymine, Guanine

ii) A sex hormone which prevents the ovulation is:

A. Progesterone
B. Corticosterone
C. Cortisone
D. Testosterone

iii) Which of the following pair of molecules undergo Diels-Alder reaction?

A. ethene and propene
B. 1,3-butadiene and ethene
C. ethene and 1-butene
D. 2-butene and 1-butene

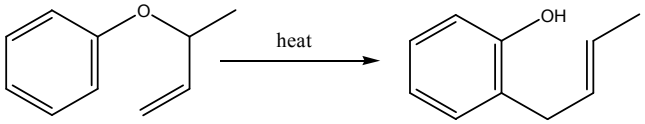
iv) Paracetamol is:

A. Para hydroxy acetanilide
B. Para hydroxy benzanilide
C. Ortho hydroxy acetanilide
D. Ortho hydroxy benzanilide

(Weightage: 1 x 5 = 5)

Section B: Short Answer
(Answer any SIX Questions)

6. Explain the reaction.

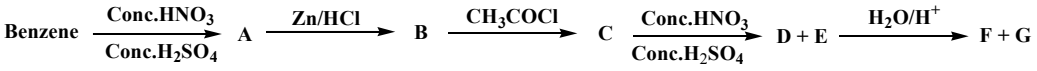


7. Glucose on treatment with Fehling's solution gives a red precipitate. Justify your observation.
8. Give any one method for the determination of the sequence of amino acids in a protein.
9. What is meant by phospholipids? Mention its biological functions.
10. Which will be more basic, pyridine or piperidine? Account.
11. Give the method of preparation of methyl orange.
12. What is chemical shift?
13. Differentiate paper and thin layer Chromatography

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. Give a short account on microwave assisted reactions in water.
15. Complete the reaction sequence.



16. Explain the preparation of soap from fats and oils.
17. Describe Watson and Crick model of DNA.
18. Explain solid phase peptide synthesis?
19. How will you distinguish $CH_3COOC_2H_5$ from $CH_3CH_2CH_2COOH$ by IR Spectroscopy?

(Weightage: 2 x 4 = 8)

Section D: Long Essay
(Answer any TWO Questions)

20. Explain the reduction product of nitrobenzene under different pH conditions?
21. Discuss Gabriel Phthalimide synthesis. How will you separate primary, secondary and tertiary amines using Hinsberg's reagent?

22. Explain Killiani-Fischer synthesis.

23. Give a detailed account on the classification of dyes.

(Weightage: 4 x 2 = 8)

Core Course – IX

ORGANIC CHEMISTRY III - SEMESTER VI

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A

(Answer ALL questions)

Choose the correct answer:

1. i) The sunshine vitamin is:

   A. Vitamin C B. Vitamin A

   C. Vitamin D D. Vitamin K

   ii) Glucose is:

   A. Disaccharide B. Monosaccharide

   C. Trisaccharide D. Polysaccharide

   iii) The monomer of Nylon 6 is:

   A. Hexamethylene diamine

   B. Adipic acid

   C. Caprolactum

   D. Adipic acid and hexamethylene diamine

   iv) Bases common to DNA & RNA are:

   A. Adenine, Cytosine, Uracil

   B. Guanine, Adinine, Cytosine

   C. Guanine, Uracil, Thymine

   D. Adinine, Thymine, Guanine

2. i) Indole is a:

   A. 1^o amine B. 2^o amine

   C. 3^o amine D. Heterocyclic amine

   ii) Fat is a:

   A. Lipid B. Protein

   C. Amino acid D. Ether

   iii) Alizarin is a:

   A. Dye B. Acid C. Aldehyde D. Ketone

   iv) Which of the following compound forms 'Zwitter ion'?

   A. Amine B. Amino acid C. Aldehyde D. ether

3. i) Diels-Alder Reaction is an example of:

   A. Electrocyclic reaction B. Cycloaddition reaction

C. Ene reaction D. Sigmatropic reaction

ii) Aniline on Benzoylation gives:

A. Phenyl acetate B. Phenyl Benzoate

C. Phenyl methyl ether D. Benzanilide

iii) Which of the following is a sex hormone?

A. DNA B. Progesterone

C. Cholesterol D. Guanidine

iv) Which of the following enzymes brings about the hydrolysis of cane sugar to glucose and fructose?

A. Invertase B. Maltase

C. Zymase D. Diastase

4. i) The sequence in which amino acids are arranged in a protein refers to:

A. 1^{o} structure B. 2^{o} structure

C. 3^{o} structure D. quaternary structure

ii) A water soluble vitamin is:

A. Vitamin A B. Vitamin C

C. Vitamin D D. Vitamin E

iii) An example of an amino acid containing sulphur is:

A. Cysteine B. Aspartic acid

C. Lysine D. Tyrosine

iv) An example of an alkaloid is:

A. Urea B. Furan

C. Indigo D. Piperine

5. i) A polysaccharide is:

A. Glucose B. Cellulose

C. Fructose D. Maltose

ii) The simplest aldose is:

A. Glyceraldehyde B. Glucose

C. Fructose D. Cane sugar

iii) Which of the following reaction will be more ecofriendly?

A. Butadiene + Maleic anhydride B. Friedel Crafts alkylation

C. Sulphonation of benzene D. Nitration of nitrobenzene

iv) The oxime of p-hydroxy acetophenone gives paracetamol by

A. Claisen rearrangement

B. Pinacol-Pinacolone rearrangement

C. Beckmann rearrangement

D. Schmidt Rearrangement

(Weightage: 1 x 5 = 5)

Section B: Short Answer

(Answer any SIX Questions)

6. Compare the basic strength of aniline, ortho nitroaniline and N-methyl aniline.
7. Draw the structure of nicotine.
8. What do you mean by isoelectric point?
9. What is the significance of Rf factor?
10. Distinguish between Vat dyes and Mordant dyes.
11. Draw the structure of cellobiose?
12. Aniline is less basic compared to ethylamine. Why?
13. How will you distinguish 1,3 pentadiene and 1,4 pentadiene by UV Spectroscopy.

(Weightage: 1 x 6 = 6)

Section C: Short Essay

(Answer any FOUR Questions)

14. Write a short note on mutarotation.
15. What are the reduction products of nitrobenzene under different media?
16. Explain green synthesis.
17. How will you convert fructose to Glucose?
18. Explain the various steps involved in the sequencing of peptides by Edman Method?
19. How will you differentiate acetone and propionaldehyde by NMR spectroscopy?

(Weightage: 2 x 4 = 8)

Section D: Essay

(Answer any TWO Questions)

20.a. Explain diazo coupling reaction and its synthetic use.

b. Explain the Basicity of Piperidine

21.a. How is ethyl acetoacetate prepared? How it is synthetically very useful compound?

b. What are lipids? Outline their biological importance.

22.a. Explain the twelve principles of Green Chemistry with examples.

b. Write a short note on Ultra sound assisted Green Synthesis.

23.a. Give the Fisher's proof to the structure of Glucose?

b. Give the biological significance of quinine.

(Weightage: 4 x 2 = 8)

Core Course – X

PHYSICAL CHEMISTRY III – SEMESTER VI

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A

(Answer ALL questions)

1. i. Find the decimal equivalent of the binary number $(1101)_2$

A. $(10)_{10}$ B. $(13)_{10}$ C. $(20)_{10}$ D. $(23)_{10}$

ii. The rate at which a substance reacts depends on its:

A. Atomic weight B. Equivalent weight

C. Molecular weight D. Active mass

iii. Which of the following is the first order reaction?

A. $NH_4NO_2 \rightarrow N_2 + 2H_2O$ B. $2HI \rightleftharpoons H_2+I_2$

C. $2NO_2 \rightarrow 2NO + O_2$ D. $2NO+O_2 \rightarrow 2NO_2$

iv. What is the direction of a reverse reaction when one of the products of the reaction is removed from it?

A. Forward B. Backward

C. Stops D. All are Correct

2. i. The rate of a chemical reaction doubles for every 10^oC rise in temperature. If the rate is increased by 60^oC, the rate of reaction increased by about:

A. 20 times B. 32 times C. 64 times D. 128 times

ii. In the electrolysis of dilute H_2SO_4 using platinum electrode:

A. H_2 is liberated at cathode B. O_2 is produced at cathode

C. Cl_2 is obtained at cathode D. NH_3 is produced at anode

iii. The standard electrode potential values of the elements A, B and C are 0.68, -2.50 and -50 V respectively. The order of their reducing power is:

A. A>B>C B. A>C>B C. C>B>A D. B>C>A

iv. In a salt bridge KCl is used because:

A. It is an electrolyte

B. It is good conductor of electricity

C. The transport number of K^+ and Cl^- are nearly same

D. It is ionic compound

3. i. At infinite dilution each ion shows a characteristic contribution to conductance which is independent of the other ions present in solution. This is the statement of:

A. Kohlrausch's law B. First law of electrolysis

C. Second law of electrolysis D. Ostwald's law

ii. The standard reduction potentials E^o for the half reaction are as :

$Zn \rightleftharpoons Zn^{2+} + 2e$, E_o=+ 0.76 V, $Fe \rightleftharpoons Fe^{2+} + 2e$, E_o = + 0.41 V.

The EMF of the cell reaction $Fe^{2+} + Zn \rightarrow Zn^2 + Fe$ is:

A. -0.35 V B. +0.35 V C. +1.17 V D. -0.17V

iii. Which of the following does not act as Bronsted acid?

A. NH_4^+ B. HSO_3^- C. HCO_3^- D. CH_3COO^-

iv. The P^{Ka} for acid A is greater than P^{Ka} for acid B, the strongest acid is:

A. Acid A B. Acid B C. Both A and B

D. Neither A nor B

4. i. If $K_a = 10^{-5}$ for a weak acid, P^{Kb} value of its conjugate base is:

A. 5 B. 6 C. 7 D. 9

ii. Conjugate base of HCO_3^- is:

A. H_2CO_3 B. CO_3^{2-} C. HCO_3^{2-} D. HCO_3^+

iii. Ionic product of water increases of:

A. Pressure is reduced B. H^+ ion is added

C. OH^- ion is added D. Temperature is increased

iv. What happens to equivalent conductance on dilution?

A. Increases B. Decreases

C. Remains same D. First decreases, then increases

5. i. Equivalent conductance at infinite dilution of a weak electrolyte can be found out by the application of:

A. Arrhenius law B. Kohlrausch's law

C. Ostwald's law D. Debye-Huckel law

ii. Transport number of an ion is:

A. Always positive B. Always negative

C. Positive or negative D. None of the above

iii. Quantum yield of Hydrogen-Chlorine reaction is:

A. 0 B. 1 C. 10^6 d. None

iv. A shift of λ_{max} to longer wave length region is called:

A. Bathochromic B. Hypsochromic

C. Hyperchromic D. Hypochromic

(Weightage: 1 x 5 = 5)

Section B: Short Answer
(Answer any SIX Questions)

6. Order of a reaction need not be whole number always. Account.

7. Give one example each for (i) a parallel reaction; (ii) a consecutive reaction.

8. What is chemiluminescence? Give one example.
9. Account for the high mobility of H^+ and OH^- ions. Why does H^+ ion moves about 50 times faster in ice than in liquid water?
10. The dissociation constant of a weak monobasic acid in aqueous solution is 8.0×10^{-5}. Calculate the degree of dissociation of 0.05 M solution of the acid.
11. How computers can be used in the calculation of molecular mass of an organic compound?
12. State and explain Michaelis – Menten equation
13. Explain Debye – Falkenhagen Effect.

(Weightage: 1 x 6 = 6)

Section C: Short Essay

(Answer any FOUR Questions)

14. Certain reactions have very high quantum yield whereas certain others have very low quantum yield. Explain.
15. State and explain Kohlrausch's law. How this law is useful for the calculation of molar ionic conductance at infinite dilution of weak electrolytes?
16. a. What is meant by electrochemical series?
    b. Write the half cell reaction for the electrochemical cell involving
    $Zn_{(s)} + 2AgCl_{(s)} \rightleftharpoons 2Ag_{(s)} + ZnCl_2$
17. In the reaction between NO and H_2 the following data are obtained.

Experiment Number	Partial Pressure of H_2 (mm)	Partial Pressure of NO (mm)	Initial Rate of reaction (m. mol s^{-1}
1	200	300	1.03
2	200	152	0.25
3	205	320	1.10
4	147	320	0.79

    a) Determine the order with respect to NO, H_2 and overall order of the reaction.
    b) Obtain the rate expression for the reaction.
18. Write down the C-programme for calculating the half life of a radio active element.
19. Derive the Henderson equation.

(Weightage: 2 x 4 = 8)

Section D: Essay

(Answer any TWO Questions)

20.a) What are buffer solutions? Explain the terms buffer index and buffer capacity.

b) Discuss briefly the principle of the polarographic method of analysis and explain the significance of limiting current and half-wave potential.

21.a) Derive an expression for the rate constant of a bimolecular gaseous reaction using collision theory.

b) The activation energy of a first order reaction is 250 $KJmol^{-1}$. The half life of the reaction is 6.5×10^6 second at 450^oC. What will be the half life at 550^oC?

22.a) What is meant by transport number of an ion? Outline the principle behind the Hittorf's method for the determination of transport number.

b) What is the principle behind conductometric titrations? Discuss the titration curves obtained in the titration of

a) a strong acid with a strong base.

b) a strong acid with a weak base.

c) a mixture of strong and weak acid with a strong base.

23.a) Outline the mechanism and kinetics of enzyme catalyzed reaction.

b) Outline the electrochemical principle of corrosion

(Weightage: 4 x 2 = 8)

Core Course – X

PHYSICAL CHEMISTRY III – SEMESTER VI

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A: Objective Questions

(Answer ALL Questions)

1. i. The $t_{½}$ of a reaction is doubled as the initial concentration of the reactant is doubled. The order of the reaction is:

A. 0 B. 1 C. 2 D. 3/2

ii. E_a for the reaction is 40 $KJmol^{-1}$ and for the reverse reaction is 60 $KJmol^{1}$. The reaction is:

A. Endothermic B. Exothermic

C. Chain D. Spontaneous

iii. At 25°C, the molar conductance at infinite dilution of HCl, CH_3COONa and NaCl are 26.1, 91 and 126.4 Sm^2mol^{-1}. Molar conductance of acetic acid at infinite dilution in Sm^2mol^{-1} is:

A. 191.6 B. 390.65 C. 389.6 D. 350

iv. At 0°K the cell potential is:

A. Equal to zero B. Equal to E^o

C. Less than E^o D. Equal to 1 Volt

2. i. A reaction is second order with respect to the reactant. How the rate of the reaction is affected if the concentration is reduced to ½?

A. Reduced to ½ of its initial rate

B. Reduced to $1/4^{th}$ of its initial rate.

C. Remains the same

D. Reduced to $1/8^{th}$ of its original rate.

ii. In the lead-acid battery, during charging, the cathode reaction is:

A. Formation of $PbSO_4$ B. Reduction of Pb^{2+} to $Pb_{(s)}$

C. Formation of PbO_2 D. Deposition of Pb at the anode

iii. Which of the following metal possess zero hydrogen over voltage?

a. Hg B. Pb C. Pt D. Ni

iv. pH of an aqueous solution containing H^+ ion concentration = 3 x 10^{-3} M is:

A. 2.47 B. 2.523 C. 3 D. 7

3.i. Solubility product of a sparingly soluble salt AB at room temperature is 1.2 x $10^{-6}M^2$. The molar solubility is:

A. 1.2 x 10^{-6} M B. 1.1 x 10^{-4} M

C. 1.1 x 10^{-3} M D. 0.6 x 10^{-3} M

ii. The unit of specific conductance is:

A. m^2 B. mS^{-1} C. $msec^{-1}$ d. Sm^{-1}

iii. At 25°C the molar conductance λ_m of a dilute solution of acetic acid is 15.0 Sm^2mol^{-1} and molar conductance (λ^{α}) at infinite dilution is 390.0 Sm^2mol^{-1}. The degree of dissociation of the acid is:

A. 3.6% B. 3.75% C. 3.85% D. 4%

iv. In the steady state approximation, if I is the intermediate formed, then

A. [I] = 0 B. [I] ≠ 0

C. $\frac{d[I]}{dt}=0$ D. $\frac{d[I]}{dt}\neq 0$

4.i. In the surface catalysis the rate determining step is:

A. Adsorption of the reactant molecules at the surface.

B. Chemical reaction occurring at the surface.

C. Chemical reaction occurring at the surface.

D. Desorption of the products from the surface

ii. Photochemical reaction are carried out by the action of:

A. Microwave radiation B. X-rays

C. UV-visible radiation D. γ radiation

iii. Phosphorescence is due to transition from:

A. T_1 to S_0 B. S_1 to S_0

C. S_1 to T_1 D. T_1 to T_2

iv. When same quantity of current is passed through a 1 molar aqueous solution of NaCl, $CuSO_4$ and $AlCl_3$, the mass of Na: Cu: Al deposited at the cathode is in the ratio:

A. 3:2:1 B. 2:3:1 C. 1:2:1 D. 1:2:3

5.i. 75% of a first order reaction is completed in 32 minutes. When its half is completed?

A. 8min B. 16min C. 24min D. 40min

ii. The standard reduction potential of the following four metals with its metal ion is given as follows.

Na/Na^+ = -2.75 V, Zn/Zn^{2+} = -0.76 V,

Cd/Cd^{2+} = -0.40V, Sn/Sn^{2+} = -0.15 V.

The order of the reducing power is:

A. Na > Zn > Cd > Sn B. Zn > Cd > Sn > Na

C. Na > Cd > Zn > Sn D. Sn > Cd > Zn > Na

iii. For the Zn/Cu cell E^o = 1.10 Volt. If the reduction potential of Cu^{2+}/Cu is 0.34 Volt, then the reduction potential of Zn^{2+}/Zn is:

A. -0.76 Volt B. 0.76 Volt C. 7.6 Volt D. 0.38 Volt

iv. In the hydrolytic equilibrium $A^- + H_2O \rightleftharpoons HA + OH^-$, $K_a = 1.0 \times 10^{-5}$. The hydrolysis constant (K_h) of the salt is:

A. 10^{-5} B. 10^{-19} C. 10^{-9} D. 10^{9}

(Weightage: 1 x 5 = 5)

Section B: Short Answer
(Answer any SIX Questions)

6. Define quantum yield of a reaction. What is its significance?
7. What is an intermediate in a reaction? Sketch the potential energy versus extent of reaction diagram of a reaction involving one intermediate.
8. What is a buffer solution and give equation for the pH of a solution containing a mixture of sodium acetate and acetic acid.
9. What is liquid function potential? How it can be eliminated?
10. For a given reaction a plot of logarithm of rate constant against reciprocal of temperature in Kelvin is found to be a straight line. What information can you get from the slope and intercept of the plot?
11. Show that $t_{½}$ of a first order reaction is independent of initial concentration of the reactant.
12. Calculate the pH of 10^{-8}M HCl
13. Define mean ionic activity coefficient.

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. Calculate the emf of the following cell at 25°C: $Cu,Cu^{2+}(C = 0.1\ M)/H^+(C=0.01\ M),H_2(1atm);Pt$ (Given E^o of H/H^+ = 0 volt, E^o of Cu/Cu^{2+} = 0.34 volt).
15. a. Define the term ionic mobility. How it is related to molar ionic conductance?

    b. Account for the high mobility of H^+ and OH ions.
16. a. What is meant by photosensitization? Explain with a suitable example.

    b. Distinguish between fluorescence and phosphorescence.
17. Write down the program in C for the calculation of (a) normality (b) molarity.
18. What is the pH of the solution obtained when 100ml each of 0.1M NaoH and 0.2M HCl are mixed.
19. Explain the functioning of a hydrogen –oxygen fuel cell?

(Weightage: 1 x 6 = 6)

Section D: Essay

(Answer any TWO Questions)

20. a. Discuss briefly the activated complex theory of reaction.

    b. The rate constant for a first order reaction is found to be 3.5×10^{-5} at $25^{o}C$.The energy of the activation is 105 KJ. Calculate the rate constant of the same reaction at $75^{o}C$.

21. a. Draw the Jablonsky diagram and explain the various photophysical process using the diagram.

    b. Define pH of a solution. Outline the principle behind the determination of pH of a solution using quinhydrone electrode.

22. a. What is a fuel cell? Explain the working of a Hydrogen oxygen fuel cell.

    b. Define Transport number. Outline the principle behind the moving boundary method for the determination of transport number.

23. a. What is meant by salt hydrolysis? Derive the relationship of the degree of hydrolysis of the salt CH_3COONa with K_w and K_a.

    b. A monochromatic radiation is incident on a solution of 0.05 M concentration of its absorbing substance. Calculate the thickness of the solution at which the intensity of the radiation is reduced to one fourth of its initial intensity. (The molar extinction coefficient of the substance in 1.204 $dm^3mol^{-1}cm^{-1}$)

(Weightage: 4 x 2 = 8)

MODEL QUESTION PAPER

OPEN COURSE I & ELECTIVE COURSE

Open Course I

Model Question Paper

Semester V (Open course)

Plastics and Rubbers in Everyday Life

Time: 3 hrs ***Maximum Weightage : 27***

Section A

(Answer ALL Questions)

Choose the correct answer:

1. i) In which of the following class would you place SBR?
   (a) Homopolymer (b) Copolymer
   (c) Branched polymer (d) Resin
   ii) Terylene is the example of:
   (a) Plastic (b) Resin
   (c) Elastomer (d) Fibre
   iii) Number of monomer units present in a polymer chain is called:
   (a) Number average molecular mass (b) Functionality
   (c) Degree of Polymerisation (d) Weight average molecular mass
   iv) The polymer used in nonstick cookware is:
   (a) Polytetrafluoroethylene (b) Chlorofluorocarbons
   (c) Polyethylene (d) Polyacrylates
2. i) Which of the following is an example of engineering plastic?
   (a) PVC (b) Polycarbonate
   (c) HDPE (d) PS
   ii) Which of the following is not an example of biodegradable polymer?
   (a) PLA (b) PGA
   (c) PHBV (d) PP
   iii) The monomer of Nylon-6 is:
   (a) Hexamethylenediamine (b) Polyamines
   (c) Nylon-6,6 (d) Caprolactum
   iv) The substance used for compounding rubber:
   (a) ZnO (b) Wax
   (c) 1,3-butadiene (d) Ethylene
3. i) Protein is:
   (a) Inorganic polymer (b) Natural polymer
   (c) Copolymer (d) Graft polymer

ii) Polyaniline is an example of:

(a) Polyamide (b) Elastomer

(c) Conducting polymer (d) Fibre

iii) The basic units present in a polymer chain is called _____.

iv) _____ is an example of thermosetting plastic.

4. i) _____ is added to reduce the cost of polymer product.

ii) PET bottles are manufactured by _____.

iii) DOT is added as _____ during polymer compounding.

iv) _____ is used for preparing carry bags.

5. i) Natural rubber is _____ isomer.

ii) _____ is used for making tubes of automobile tyres.

iii) _____ are the examples of Adhesives.

iv) _____ polymer is the basic cause for the depletion of the ozone layer.

(Weightage: 1 x 5 = 5)

Section B: Short Answers

(Answer any SIX Questions)

6. Distinguish between branched and crosslinked polymer.
7. Write the composition of natural rubber.
8. What is PMMA?
9. What is thermosetting plastic?
10. What is mastication?
11. Write two examples of polymers used in biomedical application.
12. What are conducting polymers?
13. Distinguish between number average and weight average molecular weight.

(Weightage: 1 x 6 = 6)

Section C : Short Essay

(Answer any FOUR Questions)

14. Write a short note on biodegradable polymers.
15. Specify the monomers used for making nylon 6,6 & butyl rubber. Write any two application of these.
16. Write a short note on pollution caused by polymers.
17. Write a note on adhesives.
18. Write briefly on engineering polymers
19. Discuss about the fluxional properties of polymers

(Weightage: 2 x 4 = 8)

Section D : Long Essay

(Answer any TWO Questions)

20. Write in detail the additives used in plastic compounding. Mention their function.

21. Write any two moulding technique used for plastic processing.

22. Write short notes on:

    (a) Conducting polymers (b) Engineering plastic

    (c) Laminates

23. Give the properties and application of the following polymers:

    (a) PVC (b) PET

    (c) NBR (d) PBD

(Weightage: 4 x 2 = 8)

Open Course I

Model Question Paper

Semester V (Open course)

Plastics and Rubbers in Everyday Life

Time: 3 hrs ***Maximum Weightage : 27***

Section A

(Answer ALL Questions)

Choose the correct answer:

1. i)Which of the following is a copolymer?
   (a) PE (b) PP
   (c) PTFE (d) Nitrile rubber

ii) Natural silk is:
   (a) Polypeptide (b) Polysaccharide
   (c) Polyacrylide (d) Polychloroprene

iii) Gutta Percha is:
   (a) *Trans* polyisoprene (b) Synthetic polymer
   (c) *Cis* polyisoprene (d) Polyethylene

iv) The polymer used for making contact lense is:
   (a) PVC (b) PP
   (c) PE (d) PMMA

2. i)Polylactone is a
   (a) Synthetic polymer (b) Biopolymer
   (c) Thermosetting polymer (d) Fibre

ii) Which one of the following polymer cannot be recycled?
   (a) Bakelite (b) PE
   (c) PP (d) PVC

iii) Polystyrene is an example of:
   (a) Thermosetting plastic (b) Elastomer
   (c) Thermoplastic (d) Resin

iv) Polymer present in paints is:
   (a) Polyaniline (b) Polyacrylides
   (c) Polystyrene (d) Polyamide

3. i)Tensile strength of a material not depends upon:
   (a) Molecular weight (b) Degree of polymerization
   (c) Crystallinity (d) Monomer

ii) Which of the following is used as vulcanizing agent?

(a) $CaCO_3$ (b) C-black

(c) DCP (d) Clay

iii). Crosslinking of polymers depends on _____.

iv) NBR is an example of _____.

4. i)_____ polymer is easily recycled.

ii) _____ polymer is easily biodegradable.

iii) The adhesive obtained from the bark of the tree is _____.

iv) Most versatile polymer is _____.

5. i)_____ polymer is used for making artificial valves and muscles for human body.

ii) Thermocol is _____ polymer.

iii) _____ polymer is used for the manufacture of doors of aeroplane.

iv) _____ rubber has highest abrasion resistance.

(Weightage: 1 x 5 = 5)

Section B: Short Answer

(Answer any SIX Questions)

6. What do you mean by functionality?
7. How Nylon-6 is prepared?
8. Write the monomers used for making terylene.
9. What do you mean by compounding of polymers?
10. Give any two applications of polycarbonate.
11. Define thermosetting plastic.
12. What are laminates
13. Distinguish between number average and weight average molecular weight?

(Weightage: 1 x 6 = 6)

Section C: Short Essay

(Answer any FOUR Questions)

14. Write a note on: (a) Number average molecular weight (b) Weight average molecular weight.
15. Write a short note on conducting polymers.
16. Write the monomers used for making NBR and PMMA. Mention their application.
17. Write a note on liquid crystalline polymer.

18. Write a note on biodegradable polymers.

19. Discuss about the fluxional properties of polymers.

(Weightage: 2 x 4 = 8)

Section D: Long Essay

(Answer any TWO Questions)

20. Write notes on: (1) Adhesive coating (b) Polymers used in biomedical applications.

21. Explain in detail the working of injection moulding machine. What type of articles can be prepared by this technique?

22. Give the physical properties and application of following polymers:

    (a) Polycarbonates (b) SBR

    (c) Nylon-6 (d) Butyl rubber

23. Give the various compounding additives used in rubber processing. Write their function.

(Weightage: 2 x 4 = 8)

Elective Course (Polymer)

Model Question Paper

Elective Course

Chemistry & Technology of Polymers

Time: 3 hrs ***Maximum Weightage : 27***

Section A

(Answer ALL Questions)

Choose the correct answer:

1. i) Nylon is an example of:
   (a) Plastic (b) Fibre
   (c) Elastomer (d) Resin
   ii) Which among the following form cyclic amide?
   (a) Terylene (b) Nylon-6,6
   (c Nylon 6,10 (d) Nylon-6
   iii) Who is the Father of Polymer Science?
   (a) Ziegler (b) Natta
   (c) Staudinge (d) Flory
   iv) Which of the following is used as cross linking agent?
   (a) S (b) N_2
   (c) CO (d) CO_2
2. i) Which of the following is the example of thermosetting plastic?
   (a) PVC (b) Melamine formaldehyde
   (c) Nylon (d) PP
   ii) DOT is used as
   (a) Vulcanizing agent (b) Filler
   (c) Plasticizer (d) Antioxidant
   iii) MBT is used as:
   (a) Filler (b) Accelerator
   (c) Antidegradant (d) Plasticizer
   iv) Cold drawing of fibre forming polymer induces:
   (a) Amorphous character (b) Plasticity
   (c) Tensile strength (d) Flexibility
3. i) Which of the following is reinforcement?
   (a) Carbon black (b) Clay
   (c) $CaCO_3$ (d) ZnO

ii) Which of the following is an engineering plastic?

(a) PP (b) PE

(c) PVC (d) Polycarbonate

iii) SBR is an example of:

(a) Homopolymer (b) Graft polymer

(c) Random copolymer (d) Block polymer

iv) Bakelite is a product formed from:

(a) Reaction of formaldehyde with phenol

(b) Reaction of polyethylene with phenol

(c) Reaction of polypropylene with acid

(d) It is a natural product

4. i) Ziegler-Natta catalyst is used for the synthesis of:

(a) Condensation polymer (b) Stereoregular polymer

(c) Branched polymer` (d) Thermosetting resin

ii) Extrusion moulding is used for the production of:

(a) Small articles (b) Hollow articles

(c) Intricate articles (d) Articles of continuous length

iii) If T_g of a polymer is below room temperature, then polymer will be a:

(a) Thermosetting plastic (b) Thermoplastic

(c) Elastomer (d) Hard plastic

iv) Tensile strength of a polymeric material is based on

(a) Molecular weight (b) Crystallinity

(c) Stereo regularity (d) All of these

5. i) Objects of intricate pattern are generally made by:

(a) Compression moulding (b) Transfer moulding

(c) Blow moulding (d) Rotational moulding

ii) Which of the following is an oil resistant polymer?

(a) NR (b) SBR

(c) PBD (d) NBR

iii) Moulding technique not used for rubber:

(a) Compression (b) Calendering

(c) Extrusion (d) Blow moulding

iv) A Thermoplastic among the following is

a) PVC b)PP c)Nylon d) Melaxine formaldehyde

(Weightage: 1 x 5 = 5)

Section B : Short Answer

(Answer any SIX Questions)

6. Give one example each for block and random copolymer.
7. What is meant by gelation?
8. Give the name and action of one redox initiator.
9. Explain the term chain transfer agent. Give an example showing how it functions.
10. What are antioxidants? Give two examples.
11. Explain creep behaviour of polymer.
12. Distinguish between number average and weight average molecular weight
13. Define the term viscoelasticity

(Weightage: 1 x 6 = 6)

Section C : Short Essay

(Answer any FOUR Questions)

14. Write a note on silicon polymer.
15. Write briefly about polycarbonates.
16. Describe the process of calendering.
17. Write the mechanism of anionic polymerization.
18. Write a note on co-ordination polymerisation.
19. Write briefly on engineering plastics.

(Weightage: 2 x 4 = 8)

Section D : Long Essay

(Answer any TWO Questions)

20. Write the mechanism of cationic polymerization with suitable example.
21. Make a comparative study of injection moulding, compression moulding and blow moulding of plastic products.
22. Explain in detail the compounding of plastic. Give the functions of each addition.
23. Write a note on the preparation, properties and application of: (a) Polychloroprene rubber (b) Nylon

(Weightage: 4 x 2 = 8)

Elective Course (Polymer)

Model Question Paper

Semester VI – Elective Course

Chemistry & Technology of Polymers

Time: 3 hrs ***Maximum Weightage : 27***

Section A

(Answer ALL Questions)

Choose the correct answer:

1. i) Intermolecular interactions are maximum for:

   (a) Plastic (b) Elastomers

   (c) Fibre (d) Resin

   ii) Reinforced plastic is called:

   (a) Composite (b) Blend

   (c) Resin (d) All of the above.

   iii) Caprolactum polymerizes to give:

   (a) Terylene (b) Teflon

   (c) Glyptal (c) Nylon 6

   iv) The catalyst used for the polymerization of olefins is

   (a) Wilkinson's catalyst (b) Ziegler Natta catalyst

   (c) Pd-catalyst (d) Zeise's salt complex

2. i) Polydisperity Index values of some polymers are given below. Which one of the following shows superior mechanical properties?

   (a) 2 (b) 2.2

   (c) 2.5 (d) 3

   ii) Which polymer is called flexy glass?

   (a) PMMA (b) PVC

   (c) PP (d) Nylon

   iii) NR latex is colloidal dispersion of:

   (a) *Cis*-polyisoprene (b) *Trans*-polyisoprene

   (c) Chloroisoporene (d) Isobutylene

   iv) Polymer showing highest T_g

   (a) HDPE (b) LDPE

   (c) LLDPE (d) PS

3. i) Monomers of NBR is:

   (a) Acrylonitrile & butadiene (b) Acrylonitrile & Isobutylene

(c) Acrylonitrile & Styrene (d) Adipic acid & styrene

ii) The substance used to harden the rubber for tyre manufacture is:

(a) Wax (b) 1,3-butadiene

(c) CaC_2 (d) Carbon black

iii) Which of the following is a chain growth polymer?

(a) Starch (b) Nucleic acid

(c) Polystyrene (d) Protein

iv) Impact strength is maximum for:

(a) PS (b) PVC

(c) PBD (d) SBR

4. i) Plastic bottles are manufactured by

(a) Injection moulding (b) Calendering

(c) Blow moulding (d) Compression moulding

ii) Water storage tank is manufactured by:

(a) Injection moulding (b) Compression moulding

(c) Transfer moulding (d) Rotational moulding

iii) $F_2C=CF_2$ is a monomer of:

(a) Teflon (b) Glyptal

(c) Nylon-6 (d) Buna-S

iv) Which of the following monomer is polymerized by cationic polymerization?

(a) $CH_2=CH_2$ (b) $CH_2=CH–CN$

(c) $CH_2=CH–CH_3$ (d) $CF_2=CF_2$

5. i) Living polymerization is also known as:

(a) Cationic (b) Anionic

(c) Coordination (d) Condensation

ii) Cellulose acetate is a:

(a) Natural polymer (b) Semisynthetic polymer

(c) Synthetic polymer (d) Plasticizer

iii) The first manmade fully synthetic plastic is:

(a) Bakelite (b) Nitrocellulose

(c) Nylon (d) LDPE

iv) Rubber is compounded by using:

(a) Extruder (b) UTM

(c) Internal mixer (d) Injection moulding

(Weightage: 1 x 5 = 5)

Section B : Short Answer

(Answer any SIX Questions)

6. Why PMMA is transparent while HDPE is not?
7. Halogen containing polymers should not be burnt. Why?
8. What are colorants used in polymer processing?
9. What are the monomers used for the preparation of polycarbonate?
10. What are the benefits of adding fillers to polymers?
11. What do you mean by functionality?
12. Distinguish between weight average and number average molecular weight?
13. What is viscoelasticity?

(Weightage: 1 x 6 = 6)

Section C : Short Essay

(Answer any FOUR Questions)

14. Compare the properties of LDPE and HDPE.
15. Explain addition and step growth polymerization. Compare them.
16. Write a note on silicon polymer.
17. Briefly describe the blow moulding process.
18. Write a note on tacticity of polymers.
19. What is coordination polymerisation? Explain?

(Weightage: 2 x 4 = 8)

Section D : Long Essay

(Answer ANY TWO questions)

20. Write the mechanism and characteristics of free radical polymerization with suitable example.
21. Write short note on:
    (a) Calendaring (b) Injection moulding
    (c) Compression (d) Transfer moulding
22. What are the different types of additives used in plastic compounding? Explain their function.
23. Give the methods of preparation, properties and application of the following polymers:
    (a) PVC (b) Polystyrene

(Weightage: 4 x 2 = 8)

MODEL QUESTION PAPER

COMPLEMENTARY COURSE

SEMESTER I - COMPLEMENTARY CHEMISTRY

GENERAL CHEMISTRY

MODEL QUESTION PAPER

Weightage 27

Time :3hrs

Section A

Choose the correct answer

1. Chlorofluorocarbons rise to the stratosphere and

A. reacts directly with stratospheric ozone to destroy it.

B. after interacting with UV energy becomes free radicals, which destroy ozone.

C. becomes free radicals that react with oxygen to create ozone.

D. reacts with free radicals to remove carbon dioxide

2. Which among the following gases does not contribute to global warming?

A. Argon B. Carbon dioxide C. Chlorofluorocarbons D. Nitrous oxide

3. Results of the Montreal protocol include

A. greatly reduced production of CFCs.

B. increased production of alternatives to CFCs.

C. recycling of CFCs.

D. All of the choices are correct.

4 Which of the following is *not* one of the prime health risks associated with greater UV radiation through the atmosphere due to depletion of stratospheric ozone?

A.Decreased immune system B.Damage to eyes

C.Increased skin cancer D. increased liver cancer

5. The hybridization of sulphur dioxide is:

A. sp B. sp^2 C. dsp^2 D. sp^3

6. The principal quantum number of an atom is related to the

a. size of the orbital b. spin angular momentum

c. orbital angular momentum d. orientation of the orbital in space

7. Which of the following molecules has the least tendency to form hydrogen bonds?

A.HF B. NH_3 C. HCl D.H_2O

8. Which of the following is paramagnetic and also has a bond order equal to 0.5?

A.O_2 B.N_2 C. He_2 D. H_2^+

9. Most hazardous pollutant of automobile exhaust is .

A. Mercury B. Cadmium C. Lead D.Copper

10. Which is the metal found in Vitamin B_{12}

A.Cobalt B.Nickel C.Iron D.Magnesium

11.The second largest amount of transition metal found in humans after iron is

A.Cobalt B.ZincC.Nickel

D.Copper

12. The pH of .02 N HNO_3

A. -1.6990 B.1.6990 C.1.3010 D.6990

13. The indicator methyl orange changes colour in the pH range

A. 8-9.5 B. 3.1-4.4 C. 4.2-6.3 D.10.1-12

14. The dissociation of ammonium hydroxide is suppressed on the addition of ammonium chloride which is a strong electrolyte .This phenomenon is called

A. Buffer action
B. Solubility product principle
C. Common ion effect
D. None of these.

15. An example for redox indicator is

A. methyl orange

B. phenolphthalein

C. Diphenyl amine

D. Methyl red

Fill in the blanks

16. The outer mantle of solid earth is called----------

17. The dissolved oxygen in water is expressed as----------

18. The bond order of O_2^- is----------

19. The indicator used in the titration of oxalic acid vs KOH is _____

20. An example for an acid buffer is ----------

Section B

(Answer 10 questions)

21. Distinguish between a pollutant and a contaminant .Give one example of each?

22. What are the common heavy metal pollutants in water? How do they reach the water source?

23. How are the properties of water affected by hydrogen bonding?

24. Predict the shape of SF4 on the basis of VSEPR theory.

25. How does oxygen transport occur in biological systems?

26. Differentiate between precision and accuracy.

Section C.

27. What is meant by green house effect? Mention its harmful effects.

28. Outline the molecular orbital theory of bonding. Give the molecular orbital configuration of B_2 and C_2 and calculate the bond orders. Which of them will be paramagnetic?

29. a)Briefly outline the role of Zinc and Cobalt in living systems.
    b) Write a note on Sodium and Potassium pump

30. Write an note on paper chromatography.What is meant by Rf value?

Section D

31. Write notes on

a) Global warming

b) Ion exchange method of water purification.

c) Pesticides, their toxicity and environmental hazards.

32. a) What is hybridization of orbitals ? Discuss the hybridization in PCl_5 and SF_6 and give their shapes.

b) Write down the Born Haber Cycle for $BaCl_2$ and Mention its two applications.

33. a) Distinguish between haemoglobin and myoglobin on the basis of their structure and functions

b) Explain the roles of haemoglobin and myoglobin in oxygen transport and storage.

c) How is haemoglobin affected by carbon dioxide?

34.a) Discuss the principles of adsorption and partition chromatography.

b) Discuss the principle involved in the separation of i) II group cations from other groups and ii) III group cations from other groups.

COMPLEMENTARY CHEMISTRY – SEMESTER II
INORGANIC & PHYSICAL CHEMISTRY II
MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A
(Answer ALL Questions)

1. i) Number of IR active vibrational modes possible for CO_2.
   A. 3 B. 4
   C. 2 D. 1
   ii) In first order reaction, concentration of reactant is reduced to 25% in 1 hour. Half life period is
   A. 2 hrs B. 4 hrs
   C. ½ hrs D. ¼ hrs

   iii) Which of the following posses a nuclear spin
   A. $_8O^{16}$ B. $_9F^{19}$
   C. $_6C^{12}$ D. $_1H^1$
   iv) Units of rate constant and rate of the reaction are same for
   A. First B. Second
   C. Third D. Zero

2. i) Reference compound used in NMR spectroscopy is ----------.
   ii) Force constant is ---------- related to bond order.
   iii) Effect of temperature on reaction rate is given by ---------- equation.
   iv) Foreign substance retarding the speed of a chemical reaction is called ----------.
3. i) Value of activation energy for a chemical reaction is primarily dependant on
   A. Temperature B. Nature of reactant species
   C. Collision frequency D. Concentration of reactants
   ii) Which of the following is an example of a body centered cubic crystal
   A. Mg B. Cu
   C. Zn D. Na
   iii) Isotope used in radiodiagnosis
   A. Na^{23} B. Co^{58}
   C. P^{31} D. I^{130}
   iv) Isobar of $_{20}Ca^{40}$
   A. $_{18}Ar^{40}$ B. $_{20}Ca^{38}$
   C. $_{20}Ca^{42}$ D. $_{18}Ar^{38}$
4. i) Chromophore group in 2-butanone is ----------.
   ii) Density of a crystal remains unchanged in ---------- defect.
   iii) Sites from where anions are missing and vacant sites occupied by electrons are called ----------.
   iv) Radiationless transitions from singlert to triplet state is called ----------.
5. i) Bravais lattice are of ---------- types.

ii) Two nuclei which are not identical but have same number of nucleons are called ----------.
iii) The particle emitted during the reaction is ----------.
iv) Co-ordination number of Cl in NaCl is ----------.

(Weightage: 1 x 5 = 5)

Section B

(Answer any SIX Questions)

6. Differentiate between order and molecularity of a reaction.
7. Define quantum yield. Predict about the possibility of quantum yield becoming greater than one.
8. State the selection rules for the occurrence of a) rotational transitions b) vibrational transitions.
9. Mention the principle of UV spectroscopy.
10. Define mass defect and mention its significance.
11. Mention the different types of liquid crystals.
12. What is radio carbon dating?
13. How many α and β particles are emitted in the conversion of $_{92}U^{238}$ to $_{82}Pb^{206}$.

(Weightage: 1 x 6 = 6)

Section C

(Answer any FOUR Questions)

14. Correlate nuclear stability and n/p ratio.
15. Discuss the different types of bonding in solids.
16. Frequency separation of successive lines in the rotational spectrum of HCl is 21.18cm^{-1}. Calculate the bond length of HCl.
17. Discuss briefly the theory of heterogeneous catalysis.
18. What is meant by Schottky defect? Give 2 examples?
19. Depict the different Vibrations of H_2O molecules and name them?

(Weightage: 2 x 4 = 8)

Section D

(Answerany TWO Questions)

20. a) Comment on the influence of reaction temperature on reaction rate and explain the graphical evaluation of Arrhenius parameters.
    b) A first order reaction has activation energy of 2.5 x 10^4 J/mol. A = 5 x 10^3.
21. a) Write a short note on the principle and applications of NMR spectroscopy.
    b) Distinguish between the NMR spectrum of 1,3-dibromopropane and 1,2-dibromopropane.
22. a) Derive Braggs equation.

b) Explain the utility of the equation in determining crystal structure.

23. a) Discuss the application of radioisotopes as tracers.
    b) Outline the principle of rock dating. A certain rock sample contains U^{238} and Pb^{206} in the mass ratio 5:4.Calculate the age of the rock. Half life of U^{238} is 4.8×10^{9} years.

(Weightage: 4 x 2 = 8)

COMPLEMENTARY CHEMISTRY – SEMESTER II
INORGANIC & PHYSICAL CHEMISTRY II
MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A
(Answer ALL Questions)

1. i) Catalyst in Fischer Tropsch process is

   A. Co B. Mo
   C. Ni D. Fe

   ii) Unit of rate constant of a zero order reaction is

   A. litre/sec B. mol/litre sec
   C. mol litre/sec D. mol/sec

   iii) Chemical reaction X→Y is a second order reaction.If the concentration of X is doubled, the increase in the rate of formation of Y is by a factor of

   A. 2 B. 1/2
   C. 1/4 D. 4

   iv) Each molecule getting activated by light in a photochemical process absorbs one quantum of the radiation. This law is called

   A. Grotthuss Draper law B. First law of photochemistry
   C. Stark Einstein law D. Beer Lamberts law

2. i) Property of vision depends on the photochemical transformation of ---------- to ----------.

   ii) Group of fat soluble vitamins formed by irradiation of sterols by UV light is ----------.

   iii) Benzene in NMR Spectroscopy gives---------- signal(s).

   iv) Chemical shift of $_1H^1$ on δ scale is 2.56. Its τ value is ----------.

3. i) Example for a non directional bond is

   A. metallic bond B. ionic bond
   C. covalent bond D. co-ordinate bond

   ii) Which of the following does not show IR spectrum?

   A. C_2H_2 B. HF
   C. NO D. CO

   iii) Which of the following electronic transition is forbidden?

   A. π→ π* B. None
   C. n→ π* D. n→σ*

   iv) Ethane shows

   A. n→ π* B. n→σ*
   C. π→ π* D. σ→σ*

4. i) Example of a hexagonal crystal is

A.	$CaSO_4$	B.	Graphite
C.	NaCl	D.	Diamond

ii) Temperature at which liquid crystals convert to isotropic transparent liquid is called

A.	Transparency temperature	B.	Solidification temperature
C.	Transition temperature	D.	Inversion temperature

iii)Number of atoms per unit cell in a face centered cubic crystal is

A.	3	B.	4
C.	2	D.	1

iv)Species formed in the reaction $_{24}Mn^{55}$ (n,γ) is

A.	$_{24}Cr^{55}$	B.	$_{25}Mn^{55}$
C.	$_{24}Cr^{56}$	D.	$_{25}Mn^{55}$

5. i) Density of a crystal remains unchanged in ---------- defect.

   ii) Hydrogen bombs are based on----------.

   iii) Rate of diffusion of a gas is ---------- proportional to square root of density.

   iv) Tracer used to determine the uptake of vitamin B12 is ----------.

(Weightage: 1 x 5 = 5)

Section B

(Answer any SIX Questions)

6. Reactions of molecularity higher than three are relatively rare. Why?
7. Account for the effect of temperature on reaction rate on the basis of collision theory.
8. Define zero point energy.
9. List the number of rotational modes and vibrational modes possible for acetylene molecules.
10. What are Bravais lattices? How many Bravais lattice are possible?
11. Explain the principle of Astons mass spectrograph.
12. What is the selection rule for microwave spectroscopy?
13. Hydrogen bomb is more powerful than an atomic bomb.Why?

(Weightage: 1 x 6 = 6)

Section C
(Answer any FOUR Questions)

14. Give an account of the nuclear exchange forces.
15. At what angle would the first order diffraction be observed in X-ray diffraction of a set of crystal planes for which d = 2.04 x 10-10m and l = 1.54 x 10-10 m.Also calculate the second order diffraction angle for the same.
16. Distinguish between fluorescence and phosphorescence.
17. Explain the origin of microwave spectrum and mention its application.
18. What is meant by a zero order reaction? Give example?
19. Explain the principle underlying the I.R Spectral technique.

(Weightage: 2 x 4 = 8)

Section D
(Answer any TWO Questions)

20. (a) Describe the NMR spectrum of a)dimethyl ether b) 1,4-dimethylbenzene.
    (b) Distinguish between bioluminescence and chemiluminiscence.
21. Give an account of collision theory and activated complex theory of reactions
22. (a) Write a short note on the classification of crystals on the basis of bonding.
    (b) Describe the structure of NaCl.
23. (a) Discuss the application of radioisotopes in medical field.
    (b) Explain the separation of isotopes by thermal diffusion method.

(Weightage: 4 x 2 = 8)

SEMESTER III - COMPLEMENTARY COURSE

PAPER III- ORGANIC AND BIOCHEMISTRY

Section A

Choose the correct answer

1. Which of the following species is a electrophile

A. H_2O B. NH_3 C. C_2H_5OH D. SO_3

2. Delocalization of electrons involving σ-bonds is known as

A. Mesomeric effect .B. Tautomericeffect

C.Electromeric effect D. Hyper conjugative effect

3. The shape of the carbonium ion is

A.triangular planar B. V-shaped C.Pyramidal D. None of these

4. The stability of the carbonium ion depends upon

A.The bond angle of the attached group

B. the substrate with which it reacts

C.The inductive effect of the attached group

D. None of the above

5. Which of the following compounds are optically active?

A. 2-hydroxypropanoic acid

B. 2-bromooctanol

C. teritiary butyl alcohol

D. tartaric acid

6. The lowest alkene which can exhibit geometrical isomerism is

A. Ethene B. Propene C. 1-Butene D.2-Butene

7. The most stable conformation of cyclohexane is

A. Boat form B. Half chair form C. Chair form d. Twisted form

8. The optical inactivity of meso-tartaric acid is because of

A. absence of chirality B. external compensation C. internal compensation

D. None of these

9. The characteristic absorption band of the carbonyl group in the IR spectra of CH_3COCH_3

A. 1340 cm^{-1} B. 1700 cm^{-1} C.3459 cm^{-1} D.2980 cm^{-1}

10.Caprolactum is used to prepare which of the following polymer

A. Nylon -66 B.Melamine C.Nylon-6 D. PMMA

11. Which of the following is an example of co-polymer?

A. Buna-S B.PAN C.Polythene D.PTFE

12. Vitamin D is also called

A.Ascorbic acid B.Thiamine C.Ergocalciferol D.Riboflavin

13. The source from which geraniol is extracted?

A.Lemon B. Rose C.Eucalyptus D.Orange

14. The energy currency of the cell is

A.ATP B. ADP C.ADP D.None of these

15. Which of the following does not contain metallic elements?

A.Vitamin B_{12} B. Chlorophyll C.Haemoglobin D.ATP

16. The addition of hydrogen to an alkene against Markownikoff's rule in the presence of peroxide is known as----------

17. The reaction of an aromatic compound with an alkyl halide in the presence of a Lewis acid to give alkyl benzene is called ----------

18. Nitrobenzene + NaOH $\xrightarrow{\text{heat}}$ ----------

19. The separation of a racemic mixture into *d* and *l* enantiomers is called ----------

20. The formation of hydrogen bond determines the ---------- structure of the protein

Section B

21. What are electrophiles ? How are they classified?

22. Explain nucleophilic aromatic substitution with an example.

23. Cyclopenta diene is not aromatic whereas cyclopentadienyl anion is aromatic, explain.

24. Sketch the confirmations of ethane. Which of them will be most stable?

25. Differentiate between coenzyme and isoenzyme.

26.What are thermoplastics ? Give two examples.

Section C

27.Differentiate between SN_1 and SN_2 mechanisms with examples highlighting the stereochemistry involved.

28.Explain with examples :

a) Chiral carbon b) Dissymetric molecule c)diastereomers d) Racemic mixture

29.How do RNA and DNA differ in structure, composition and functions ?

30. a)How is Bakelite prepared ? Mention its uses?

b) Give an account of synthetic fibres.

Section D

31. a) How are carbocations formed ? What are the important types of reactions undergone by them? Comment on the stability of the different types of carbiocations.

b) Explain geometrical isomerism with suitable example. How are the inter conversion of geometrical isomers possible?

32. a) Explain the splitting pattern of NMR spectra of 1-chloro propane and 2- chloro propane?

b) Write notes on a) Biodegradable plastics b) Silicones

33. a)What are enzymes ? Give four important characteristics of enzymes.

b) Write a note on metabolism of carbohydrates.

34. a) What are terpenes ? How are they classified?

b) Give the structure of citral. How is it isolated?

c) What are the important uses of essential oils?

COMPLEMENTARY CHEMISTRY – SEMESTER III
ORGANIC AND BIOCHEMISTRY
MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A
(Answer ALL Questions)

1.i) Predict the products of the reaction:

Benzene + n-propyl chloride $\xrightarrow{AlCl_3}$

ii) Arrange CH_3Cl, CH_3I, CH_3F and CH_3Br in the order of dipole moment.

iii) Give an example of non-benzenoid aromatic compound.

iv) Give one example of a bicyclic heterocyclic containing one N in the ring.

2.i) Ziegler-Natta catalyst is _____

ii) Give an example for thermosetting plastic.

iii) Name a biodegradable plastic.

iv) Name the nitrogenous base absent in DNA.

3.i) Apoenzyme-cofactor complex is called _____

ii) A nucleoside is a compound containing _____

iii) Name the sugar unit present in RNA.

iv) An example of psychedelic drug is:

A. Morphine B. LSD
C. Nicotine D. Piperine

4.i) The geometrical isomer of geraniol is:

A. Nerol B. Citral
C. Carbinol D. Resorcinol

ii) An example of narcotic drug is:

A. Heroin B. Nicotine
C. Geraniol D. Ephedrine

iii) Which of the following structures will exhibit geometrical isomerism?

A. $CH(CH_3)=CCl_2$ B. $CH_3-CH_2-CH=CH-COOH$
C. $C_6H_5-CH(OH)-COOH$ D. $CH_3-CH=CH-CH_3$

iv) Which of the following structures will exhibit optical isomerism?

A. $COOH-CH_2-CH(OH)-CH_2-COOH$
B. $CH_3-CH(OH)-CHO$
C. $H_2N-NH-C_6H_5$
D. $CH_3-CH_2-CH(NH_2)-COOH$

5.i) Which of the following compounds exhibit geometrical isomerism?

A. $(CH_3)_2C=CH(CH_3)$ B. $(CH_3)_2C=CH_2$

C. $CH_2=CH_2$ D. $CH_3\text{-}CH=CH\text{-}CH_3$

ii) Grignard reagent on reaction with H_2O gives the following class of compound:

A. Alkanes B. Alkenes

C. Alkynes D. None of these

iii) An organo metallic compound used in medicine is:

A. Cisplatin B. Grignard reagent

C. Ferrocene D. None of these

iv) Predict the products of:

(i) *propylene* + *HBr* $\xrightarrow{Peroxide}$

(ii) *2-butene* + *HCl* $\longrightarrow$

(Weightage: 1 x 5 = 5)

Section B: Short Answer
(Answer any SIX Questions)

6. What are silicones? How are they prepared?
7. What is meant by genetic code?
8. What are terpenoids? What are the natural sources of it?
9. Define the terms conformation and configuration.
10. What is a carbine? Give one reaction in which it is formed.
11. What are organometallic compounds? Give an example.
12. Give the structures of a) Pyran b)Indole
13. Write down the different isomers of 2- Butene?

(Weightage: 1 x 6 = 6)

Section C: Short Essay
(Answer any FOUR Questions)

14. Outline a method of preparation of organoborane. Mention two uses.
15. What is meant by step-growth polymerization? Explain.
16. What are the factors which influence enzyme action?
17. Draw the structures of citral and geraniol. What are the chief sources and uses of them.
18. Write on the secondary and tertiary structure of proteins?
19. What is Markownikoff's rule? Illustrate with example?

(Weightage: 2 x 4 = 8)

Section D: Essay

(Answer any TWO Questions)

20. What are enzymes? Discuss Michaelis-Menten theory of enzyme action.

21. (i) Explain conformational isomerism with respect to cyclohexane and methyl cyclohexane.

    (ii) Explain the various methods used for the resolution of a racemic mixture.

22. Differentiate between S_N1 and S_N2 mechanism. Which of these will result in inversion of configuration? What will be the mechanism followed in the hydrolysis of tertiary butyl chloride?

23. How are plastics classified? Give examples for each class. Give the methods of preparation of one from each class.

(Weightage: 4 x 2 = 8)

COMPLEMENTARY CHEMISTRY – SEMESTER IV

PHYSICAL CHEMISTRY II

MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A

(Answer ALL Questions)

1. (i) When a solid transforms into liquid at its melting point,its entropy
   A. Remains constant B. Increases
   C. Decreases D. Becomes zero
   ii) A gas shows heating effect on expansion;J.T coefficient will be
   A. +ve B. -ve
   C. 0 D. 1
   iii) An example of colligative property
   A. B.P B. F.P
   C. Vapour Pressure D. Osmotic Pressure
   iv) ΔG^o for a rection is zero implies
   A. $\Delta H^0 = 0$ B. $\Delta S^0 = 0$
   C. K (equilibrium constant) = 0 D. K = 1
2. i) Example for a secondary reference electrode is----------.
   ii) An example for a semi permeable membrane is----------.
   iii) If solid sodium acetate is added to a dilute solution of acetic acid, Ph will------.
   iv) Electrolyte in H_2-O_2 fuel cell is----------.
3. i) The total eentropy of an isolated system in which change takes place at a finite rate
   A. Decreases B. Increases
   C. Remains constant D. May increase or decreases
   ii) Two hypothetical acids HA and HB have dissociation constants 1×10^{-3} and 1×10^{-5} respectively in water. How many times HA is stronger than HB?
   A. 10 times B. 100 times
   C. 1000 times D. 50 times
   iii) For distribution of benzoic acid between water (C_1) and benzene (C_2)
   A. C_1/C_2 = constant B. $C_1/\sqrt{C_2}$ = constant
   C. $C_1/2C_2$ = constant D. $\sqrt{C_1}/C_2$ = constant
   iv) Arsenious oxide sol is ---------- charged.
4. i) Phase rule for a condensed system can be represented as ----------.
   ii) Osmotic pressure of solution is ---------- proportional to its molar volume.
   iii) Melting point of ice ---------- with increase in pressure.
   iv) Cleansing action of soap and detergents is ascribed to their ability to ---------- grease.
5. i) An example for a two component eutectic system is----------.
   ii) A plot of Π/C vs C will be a ----------.
   iii) Standard electrode potential of standard hydrogen electrode is----------.

iv) Decrase in intermolecular forces will result in a ---------- in surface tension.

(Weightage: 1 x 5 = 5)

Section B

(Answer any SIX Questions)

6. Mention the factors influencing the viscosity of aliquid.
7. Calculate the osmotic pressure of a 3% solution of sucrose (M = 342) at 300K.
8. State and explain the zeroth law of thermodynamics.
9. Give an brief outline of the calomel electrode.
10. Mention the conditions under which distribution law is valid.
11. Explain the terms Brownian movement.
12. State Hess's law?
13. Define molar refraction?

(Weightage: 1 x 6 = 6)

Section C

(Answer any FOUR Questions)

14. Write notes on a) Hardy Schulz rule b) Protective colloids.
15. State and explain the Kohlrausch's law mentioning its application.
16. Describe the experimental determination of osmotic pressure.
17. a) Explain the utility of molar refraction in structural elucidation of molecules.
    b) Refractive index of CCl4 for D-line of Sodium is 1.4573.Calculate the molar refraction (density = 1..595g/cc)
18. Explain Joule Thomson effect?
19. Write down Kirchoff's equation?

(Weightage: 2 x 4 = 8)

Section D

(Answer any TWO Questions)

20. Discuss the principle and advantages of potentiomeric titrations.
21. Explain the phase diagram of sulphur system.
22. Write a short note on a) Tyndall effect b) Electrophoresis
23. a) Distinguish between bond energt and bond dissociation energy.
    b) Calculate the enthalpy of the reaction

$$C_2H_{6\,(g)} + Br_{2\,(g)} \longrightarrow C_2H_5Br_{\,(g)} + HBr_{\,(g)}$$

Bond energies of C-H,H-Br, C-Br and Br-Br bonds are 368,276 and 192 KJ mol^{-1} respectively

(Weightage: 4 x 2 = 8)

COMPLEMENTARY CHEMISTRY – SEMESTER IV
PHYSICAL CHEMISTRY II
MODEL QUESTION PAPER

Time: 3 hrs ***Maximum Weightage: 27***

Section A
(Answer ALL Questions)

1. i) Free energy change of a reversible reaction at equilibrium state of a reaction is ----------.
   ii) Equivalent conductance ---------- with dilution.
   iii) Example of a redox indicator is ----------.
   iv) Protection of iron by coating with a layer of zinc is called----------.
2. i) When a solid melts there is
   A. No change in enthalpy B. No change in entropy
   C. Decreases in enthalpy D. Increase in enthalpy
   ii) pH of the resultant solution after hydrolysis of KCN
   A. 0 B. 7
   C. Greater than 7 D. Less than 7
   iii) The phenomenon by which gels give out small amounts of water on standing
   A. Swelling B. Synerisis
   C. Thixotropy D. Imbibition
   iv) Example for emulsion
   A. Cheese B. Cod liver oil
   C. Starch solution D. Jellies
3. i) In the case of ideal gas Joule Thomson coefficient is ----------.
   ii) Enthalpies of all elements in their standard states are ----------.
   iii) Ferric hydroxide sol is ---------- charged.
   iv) Example of distribution indicator is ----------.
4. i) Isotonic solutions have same
   A. Molality B. Molar concentration
   C. Osmotic pressure D. Elevation in B.P
   ii) Potential difference developed between upper and lower layers when a suspension settles under influence of gravity
   A. Sedimental potential B. Zeta potential
   C. M,embrane potential D. Donnan potential
   iii) Buffer capacity is maximum when
   A. pH = pKa B. pH >pKa
   C. pH <pKa D. pH = 7
   iv) Which of the following solutions has higher freezing point?
   A. 0.1 M KCl B. 0.1 M Na_2SO_4
   C. 0.1 M $AlCl_3$ D. 0.1 M $BaCl_2$
5. i) Number of phases of sulphur co-existing at the triple point in sulphur system is ----------.

ii) Transition temperature for reversible transformation of $S_R \leftrightarrow S_M$ ---------- with increase in pressure.

iii) Phase rule for a condensed system can bev represented as ----------.

iv) Metastable triple point in Sulphur system involves the equilibrium between ----------,---------- and----------.

(Weightage: 1 x 5 = 5)

Section B
(Answer any SIX Questions)

6. All the phases of sulphur cannot co-exist in equilibrium under any condition. Why?
7. Define micelle and critical micelle temperature
8. Specific conductance of a decinormal solution of an electrolyte is 2.5×10^{-4} Scm^{-1}. Calculate the equivalent conductance.
9. Define zeta potential. Give expression for zeta potential.
10. Explain optical exaltation citing example.
11. Distinguish between bond energy and bond dissociation energy.
12. Explain electro dialysis?
13. What is a buffer solution?

(Weightage: 1 x 6 = 6)

Section C
(Answer any FOUR Questions)

14. Write a short on molar polarization.
15. Explain Donnan membrane equilibrium.
16. (a) Describe the determination of solubility of a sparingly soluble salt based on conductivity measurements.

(b) Specific conductance of a saturated solution of AgCl at 298 K is 2.28×10^{-6} $ohm^{-1}cm^{-1}$.Calculate the solubility of AgCl in water (Λ^o of Ag^+ and Cl^- are 61.94 and 76.36 $ohm^{-1}cm^2mol^{-1}$ respectively. Molar mass of AgCl = 143.5).

17. Derive Gibbs Helmholtz equation.
18. Explain Fuelcell?
19. Give four methods of prevention of corrosion?

(Weightage: 2 x 4 = 8)

Section D
(Answer any TWO Questions)

20. a) Give a brief discussion on the stability of sols and their coagulation.

b) Write a short note on the applications of colloids.

21. a) State and explain the Nernst distribution law outlining its applications.
    b) The distribution coefficient of iodine between CS_2 and water is 400 in favour of CS_2. 5g of iodine is distributed between CS_2 and 200 ml water. Calculate the concentrations of iodine in water and CS_2.
22. a) Explain the principle of conductometric titrations citing any two examples.
    b) What are buffer solutions? Explain the buffer action with examples.
23. a) Explain Joule Thomson effect and discuss its application in liquefaction of gases.
    b) Mention the physical significance of entropy and free energy. Explain the criteria for spontaneity and equilibrium in terms of both.

(Weightage: 4 x 2 = 8)