KANNUR UNIVERSITY

(Abstract)

B.Sc Chemistry-Scheme & Syllabus of Core and Complementary Courses under Choice Based Credit Semester System for Under Graduate Programme-Implemented with effect from 2009 admission-Orders Issued.

ACADEMIC BRANCH

No.Acad/C2/754/2007 (1) Dated, K.U.Campus. P.O,10- 07-2009.

Read: 1.Minutes of the meeting of the Board of Studies in Chemistry (UG) held on 25-05-2009.
2. Minutes of the meeting of the Faculty of Science held on 16-06-2009.
3. U.O No.Acad/C2/3838/2008(i) dated 07-07-2009
4. Letter dated 01-07-2009 from the Chairman, BOS Chemistry (UG).

ORDER

1.The Board of Studies in Chemistry (UG) vide paper read(1) above has prepared finalized and recommended the Scheme and Syllabus of Core,Complementary and Open Courses for B.Sc Chemistry Programme under Choice Based Credit Semester System for implementation from 2009 admission.

2. The recommendations of the Board in restructuring the syllabus is considered by the Faculty of Science vide paper read (2) and recommended for the approval of the Academic Council.

3. The Regulations for Choice based Credit Semester System is implemented in this University vide paper read (3).

4. The Chairman, BOS in Chemistry (UG) vide paper read (4), forwarded the restructured scheme and syllabus Core and Complementary Courses for B.Sc Chemistry Programme under Choice Based Credit Semester System, prepared by the Board of Studies in Chemistry (UG) for implementation with effect from 2009 admission.

5. The Vice Chancellor, after examining the matter in detail, and in exercise of the powers of the Academic Council as per section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction to implement the scheme and syllabus of Core and Complementary Courses for B.Sc Chemistry Programme, restructured in line with Choice Based Credit Semester System,with effect from 2009 admission, subject to ratification by the Academic Council.

6. The restructured scheme and syllabus of Core and Complementary Courses of B.Sc Chemistry Programme under Choice Based Credit Semester System, implemented with effect from 2009 admission is appended.

7. The Scheme and Syllabus of Complementary Courses offered for this Programme will be available along with the syllabus of Core Courses of the Complementary subject.

8. The affiliated Colleges are not permitted to offer Complementary Courses in violation to the provisional/permanent affiliation granted by the University. Changes in Complementary Courses are permitted with prior sanction /revision in the affiliation order already issued in this regard.

9. If there is any inconsistency between the Regulations for CCSS and its application to the Scheme & Syllabus prepared, the former shall prevail.

10. Orders are issued accordingly.

Sd/-
To: REGISTRAR

1. The Principals of Colleges offering B.Sc Chemistry Programme.
2. The Examination Branch (through PA to CE)

Copy To:
1. The Chairman, BOS Chemistry (UG)
2. PS to VC/PA to PVC/PA to Regr
3. DR/AR I Academic
4. The Central Library
5. SF/DF/FC.

Forwarded/By Order

SECTION OFFICER

K A N NU R U N I V E R S I T Y

COURSE STRUCTURE

&

SYLLABUS

FOR

UNDERGRADUATE PROGRAMME

IN

C H E M I S T R Y

CORE &COMPLEMENTARY

COURSES

CHOICE BASED CREDIT SEMESTER SYSTEM

w.e.f 2009 ADMISSION

Curriculum

Preface

Science is pivotal to the development of any modern society. However, the creation of a scientific temper in society necessitates proper education and guidance. An effective science education can be imparted at the undergraduate level only by revamping the present curriculum. To achieve this goal, the curriculum should be restructured, giving emphasis to various aspects such as the creativity of students, knowledge of current developments in the discipline, awareness of environment impacts due to the development of science and technology, and the skills essential for handling equipment and instruments in laboratories and industries.

The Higher Education Council has taken the initiative to reformulate the undergraduate syllabi by introducing choice based credit and semester system. This is to cope with the internationally followed curricula and mode of evaluation. This approach has necessitated the revision of the present curriculum.

This curriculum is prepared to give sound knowledge and understanding of chemistry to undergraduate students. The goal of the syllabus is to make the study of chemistry stimulating, relevant and interesting. The syllabus is prepared with a view to equipping the students with the potential to contribute to academic and industrial environments. This curriculum will expose students to various fields in chemistry and develop interest in related disciplines. Chemistry, being a border science to biology, physics and engineering, has a key role to play in learning these disciplines. The new and updated syllabus is based on an interdisciplinary approach with vigour and depth. Care has been given to ensure that the syllabus is not very heavy while remaining compatible to the syllabi of other universities at the same level. Chemistry being an experimental science, sufficient emphasis is given in the syllabus for training in laboratory skills and instrumentation.

The syllabus has been prepared in a participatory manner, after discussions with a number of faculty members in the subject and also after evaluating the existing syllabi of B.Sc Part-III, the new syllabi of XI^{th} & XII^{th} standards and U.G.C. model curriculum and the syllabi of other Universities. The units of the syllabus are well defined and the scope

of each is given in detail. The number of contact hours required for each unit is also given. A list of reference books is provided at the end of each course.

Broad objectives

To enable the students

- To understand basic facts and concepts in Chemistry while retaining the exciting aspects of Chemistry so as to develop interest in the study of chemistry as a discipline.
- To acquire the knowledge of terms, facts, concepts, processes techniques and principles of the subject.
- To develop the ability to apply the principles of Chemistry.
- To be inquisitive towards advanced chemistry and developments therein.
- To appreciate the achievements in Chemistry and to know the role of Chemistry in nature and in society.
- To develop problem solving skills.
- To be familiarised with the emerging areas of Chemistry and their applications in various spheres of Chemical sciences and to apprise the students of its relevance in future studies.
- To develop skills in the proper handling of apparatus and chemicals.
- To be exposed to the different processes used in industries and their applications.

COURSE STRUCTURE FOR UG PROGRAMME
CHEMISTRY

SEMESTER 1

No	Title of the Course	Contact hours /week	Credits
1	Common Course I (English)	5	4
2	Common Course II (English)	4	3
3	Common Course I (Additional Language)	4	4
4	Core Course 1	2	2
5	Core Course 2, Practical I	2	-
6	Complementary 1 (Course I)	2	2
7	Complementary 1 Practical	2	-
8	Complementary 2 (Course I)	4	3

SEMESTER 2

No	Title of the Course	Contact hours/week	Credits
1	Common Course III (English)	5	4
2	Common Course IV (English)	4	3
3	Common Course II (Additional Language)	4	4
4	Core Course 3	2	2
5	Core Course 2, Practical I, Part II	2	4
6	Complementary 1 (Course II)	2	2
7	Complementary 1(Course II) Practical	2	-
8	Complementary 2 (Course II)	4	3

SEMESTER 3

No	Title of the Course	Contact hours/week	Credits
1	Common Course V (English)	5	4
2	Common Course III (Additional Language)	5	4
3	Core Course 4	3	3
4	Core Course 5, Practical 2,Part I	2	-

5	Complementary 1 (Course III)	3	2
6	Complementary 1 (Course III) Practical	2	-
7	Complementary 2 (Course III)	5	3

SEMESTER 4

No	Title of the Course	Contact hours/week	Credits
1	Common Course VI (English)	5	4
2	Common Course IV (Additional Language)	5	4
3	Core Course 6	3	3
4	Core Course 5, Practical 2,Part II	2	2
5	Complementary 1 (Course IV)	3	2
6	Complementary 1 (Course IV) Practical	2	4
7	Complementary 2 (Course IV)	5	3

SEMESTER 5

No	Title of the Course	Contact Hours / week	Credit
1	Open Course 1	2	2
2	Core Course 7	5	4
3	Core Course 8	4	4
4	Core Course 9	4	4
5	Core Course 10	5	-
6	Core Course 11	5	-

SEMESTER 6

No	Title of the Course	Contact Hours / week	Credit
1	Open Course 2	2	2
2	Core Course 13	5	4
3	Core Course 14	4	4
4	Core Course 15(Elective)	4	4
5	Core Course 16	5	4
6	Core Course 10& 11 Practical 3& 4	5	6
7.	Core Course 12 Project/Industrial Visit		4

Scheme for Core Course (Chemistry)

No	Semester	Course Code	Title of the course	Contact Hours/week	Credits
1	I	1B01CHE	Methodology of Chemistry as Discipline of Science	2	2
2	I	1B02CHE	Core course Practical -I Volumetric Analytics Part- I	2	-
3	II	2B03CHE	Theoretical and Inorganic Chemistry	2	2
4	II	2B02CHE	Core course practical -I Volumetric Analytics Part -II	2	4
5	III	3B04 CHE	Inorganic Chemistry-I	3	3
6	III	3B05CHE	Core Course Practical -I I Inorganic Qualitative Analysis & Preparation Part -I	2	-
7	IV	4B06 CHE	Inorganic Chemistry-II	3	3
8	IV	4B05 CHE	Core Course Practical -I I Inorganic Qualitative Analysis & Preparation Part -II	2	2
9	V	5B07 CHE	Physical Chemistry –I	5	4
10	V	5B08 CHE	Physical Methods in Chemistry	4	4
11	V	5B09 CHE	Organic Chemistry-I	4	4
12	V	5B10 CHE	Core Course Practical-III Gravimetric Analysis	5	-
13	V	5B11 CHE	Core Course Practical-IV Organic Chemistry	5	-
14	V	5B12 CHE	Project /Industrial Visit	-	4
15	VI	6B13 CHE	Physical Chemistry –II	5	4
16	VI	6B14 CHE	Organic Chemistry-II	4	4
17	VI	6B15 CHE	Elective A.Environmental Chemistry B. Food Chemistry C. Industrial Chemistry D. Synthetic Organic Chemistry E. Analytical Chemistry F. Nano Materials –Synthesis &	4	4

			Practice		
18	VI	6B10&11CHE	Core Course Practicals –III&IV	5	6
19	VI	6B16 CHE	Core Course Practical Physical Chemistry	5	4

Scheme-Complementary Course (Chemistry)

No	Semester	Course Code	Title of the course	Contact Hours/week	Credits
1	1	1CO1CHE	Chemistry(For Physical &Biological Sciences)	2	2
2	2	2CO2CHE	Chemistry(For Physical &Biological Sciences)	2	2
3	3	3CO3CHE	Chemistry(For Biological Sciences)	3	2
4	4	4CO4CHE	Chemistry(For Biological Sciences)	3	2
5	3	3CO5CHE	Chemistry(For Physical Sciences)	3	2
6	4	4CO6CHE	Chemistry(For Physical Sciences)	3	2
7	1,2,3,4	4CO7CHE	Chemistry Practicals	8	4

Scheme for Open Courses

No	Semester	Course Code	Title of the course	Contact Hr/week	Credits
1	5	5D01CHE	Chemistry in service to Man	2	2
2	5	5D02CHE	Chemistry in everyday life	2	2
3	5	5D03CHE	Environmental Studies	2	2
4	6	6D01CHE	Drugs-Use & Abuse	2	2
5	6	6D02CHE	Food Science	2	2
6	6	6D03CHE	Nano Materials Synthesis & Practice	2	2

1B01CHE – Methodology of Chemistry as a discipline of Science

Credits-2

Contact Hours-36

Aim: To illustrate the methodology of science in chemistry

Objectives :

- To have a broad outline of the methodology of science in general and Chemistry in particular.
- To understand the important analytical and instrumental tools used for practicing chemistry.
- To learn computer based presentation and statistical analysis of data using spreadsheet software.
- To apply these skills in the analysis of experimental data in chemistry practical.

Module - 1 Chemistry as a discipline of science (9 hrs)

What is Science? Scientific statements, Scientific methods – observation – posing a question – formulation of hypothesis – experiment theory – law. Falsification (disproving) of hypothesis, inductive and deductive reasoning, revision of scientific theories and laws.

Methods of science as illustrated through the following:

i) Laws of chemical combination – Faradays laws of electrolysis – Daltons atomic theory – atom models – J.J.Thomson, Rutherford, Bohr model and quantum mechanical model of atom.

ii) n-P-V-T relation of gases-gas laws – kinetic molecular theory.

Role of concepts and models in science.

Evolution of Chemistry – ancient speculations on the nature of matter, early form of chemistry – alchemy, origin of modern chemistry. Structure of chemical science: scope of chemical science, theory and experiment, branches of chemistry. Role of Chemistry as a central science connecting Physics, Biology and other branches of science. Interdisciplinary areas involving Chemistry – Nanotechnology, Biotechnology.

Chemical science in the service of man: Drugs, food, flavouring agents, sweeteners, cosmetics, soaps and detergents, paints, varnishes, textiles, dyes, fertilizers, insecticides, fuels etc. – examples in each.

Methodology of chemistry: Symbols, formulae, Chemical equations, classification (periodic classification of elements, classification of organic compounds into homologous series), Analysis (qualitative and quantitative), preparation, synthesis, manufacture.

References

1. J.A.Lee, Scientific Endeavor, Addison Wesley Longman (chapters 1 and 2)
2. C.N.R. Rao, University Chemistry, Universities Press (India) Pvt. Ltd (Chapters 1 and 2).

Module –2. Research in Science (9 hours)

Selecting a topic – hypothesis – design of experiment: variables, correlation and causality, sampling, use of controls, experimental bias, analysis, results, discussion of results, models.

Summary of the scientific methods. Writing Science

Reference

J.A.Lee, Scientific Endeavor, Addison Wesley Longman (chapters 3, 9 and Appendix 3)

Module-3. Analytical and synthetic methodologies in Chemistry (9 hours)

Titrimetric analysis : Fundamental concepts – mole, molarity, molality, ppm and ppb primary standard – secondary standard, quantitative dilution – problems. Acid base titrations – titration curves – pH indicators. Redox titrations – titration curve – titrations involving MnO_4^- and $Cr_2O_7^{2-}$ - redox indicators. Complexometric titrations – EDTA titrations – titration curves – indicators – **Gravimetric analysis**: Unit operations in gravimetric analysis illustrations using iron and barium estimation. **Synthetic methodologies** – condensation – addition – examples. Separation and purification techniques – Filtration, Crystallization and precipitation – concept of solubility product as

applied in group separation of cations – problems. Fractional distillation, Solvent extraction.

References

1. B.R.Puri, L.R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi (Chapter 40).
2. D.A.Skoog, D.M.West and S.R. Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson Chapters 12-17).
3. Vogel's Text book of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd (Chapters 10, 11).
4. G.D.Christian, Analytical Chemistry, John Wiley and Sons (Chapters 5, 7, 8, 16, 17)

Module-4. Data Analysis (9 hours)

Units, significant digits, rounding, scientific and prefix notation, graphing of data – Precision and accuracy – Types of errors – Ways of expressing precision – Ways to reduce systematic errors – reporting analytical data, Statistical treatment of analytical data – population and samples – Mean and standard deviation – distribution of random errors – confidence limits – tests of significance – Correlation and regression – linear regression analysis, calculation of regression coefficients (slope, Intercept) using scientific calculator – methods of least squares.

The following section is non-evaluative for theory examination

Familiarization of software packages for analysis and graphical representation of data – MS Excel, Origin, Open office calc (Physical Chemistry experiments using software packages are included in the 5th and 6th semesters), simulations, virtual experiments, drawing molecular structures using Chemsketch, ISIS Draw.

References

1. B.R. Puri, L.R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi (Chapter 40)
2. J.A.Lee, Scientific Endeavor, Addison Wesley Longman (Appendices 1, 2 and 4)
3. D.A.Skoog, D.M.West and S.R.Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson (Chapters 5-8)
4. Vogel's Text book of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd (Chapters 4).

5. G.D.Christian, Analytical Chemistry, John Wiley and Sons (Chapters 2)
6. R.Crouch and F.J.Holler, Applications of Microsoft Excel in Analytical S.Chemistry, Brooks/Cole.

Further Reading

1. J.Mills and P.Evans, Core Chemistry, Foundation books Pvt. Ltd, New Delhi (2004)
2. T.F.Gieryn,Cultural boundaries of science, University Chicago Press, 1999.
3. H.Collins and T.Pinch, The Golem, What everyone should know about science, Cambridge University Press, 1993.
4. Hewitt, Paul G, S.Lyons, J.A.Suchocki and J.Yeh, Conceptual Integrated Science, Addison Wesley, 2007.
5. Methods for Teaching Science as Inquiry, Allyn and Bacon, 2009.
6. K.V.S. Sarma, Statistics made simple, Prentice – Hall of India, New Delhi.
7. R.Crouch and F.J.Holler, Applications of Microsoft Excel in Analytical S.Chemistry, Brooks/Cole.
8. R.D.Jarrard, Scientific Methods, jarrad@mines.utah.edu,2001.
9. R.Sangenburg D.K.Moser, History of Science (5 Volumes), Universities Press (India) Ltd.

2B03CHE : Theoretical and Inorganic Chemistry

Credits-2

Contact Hours-36

Aim

To impart essential theoretical knowledge on atomic structure, periodic properties, chemical bonding, and nuclear chemistry.

Objectives:

- To study the various atom models.
- To understand the important features of the quantum mechanical model of the atom.
- To study the periodic properties of elements.
- To explain the formation of different types of bonds.
- To predict the geometry of simple molecules.

- To explain the different types of hybridisation and draw shapes of simple covalent molecules.
- To understand the molecular orbital theory of diatomic molecules.
- To develop interest in various branches of inorganic chemistry.
- To study nuclear models and nuclear reactions.

Module – 1. **Atomic Structure** **(10 Hrs)**

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

References

1. J.D.Lee, Concise Inorganic Chemistry, 5th edn, Blackwell Science, London (Chapter 1)
2. B.R.Puri, L.R.Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi (Chapter 1).
3. C.N.R.Rao, University General Chemistry, Macmillan, 3rd edn., John Wiley 2001 (Chapter 1).
4. F.A.Cotton, G.Wilkinson and P.L.Gans, Basic Inorganic Chemistry, 3rd edn., John Wiley (Chapter 2).
5. D.F.Shriver and P.W.Atkins, Inorganic Chemistry, 3rd edn., Oxford University Press (Chapter 1).
6. B.Douglas, D.Me Daniel, John Alexander, Concepts and models in Inorganic Chemistry (Chapter 1).

Module – 2. **Chemical Bonding** **(16 hrs)**

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

Covalent bond – valence bond theory and its limitations, concept of resonance, resonance energy, hybridisation and shapes of simple molecules (BeF_2, PCI_3, SF_6, CH_4, Ethane, ethene and ethyne) VSEPR theory, shapes of molecules and ions (NH_3, XeF_6, CIF_3, NH_4^+, H_3O^+). Molecular orbital theory – LCAO method, molecular orbital energy diagram and properties of homo and hetero diatomic molecules (N_2, O_2, CO and NO), bond strength and bond energy. Polarisation of covalent bond, polarising power and polarisability of ions, Fajan's rule.

Dipole moment and molecular structure – percentage ionic character from dipole moment.

Metallic bonding – free electron theory, valence bond theory and band theory, explanation of metallic properties based on these theories.

Weak chemical forces – hydrogen bond, inter and intra molecular hydrogen bonds, effects of hydrogen bonding, van der Waals forces.

References

1. J.D.Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London (Chapter 2-5).
2. B.R.Puri, L.R.Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi (Chapter 4, 5).
3. C.N.R.Rao, University General Chemistry, Macmillan 3rd edn., John Wiley, 2001 (Chapter 3)
4. F.A.Cotton, G.Wilkinson and P.L.Gans, Basic Inorganic Chemistry, 3rd edn., John Wiley (Chapter 3, 4).
5. D.F.Shriver and P.W.Atkins, Inorganic Chemistry, 3rd edn., Oxford University Press (Chapter 2, 3).

4. Nuclear Chemistry (10 Hrs)

Nuclear particles, nuclear forces, nuclear size, nuclear density, stability of nucleus, binding energy, magic numbers, packing fraction, n/p ratio. Nuclear models – liquid drop model and shell model.

Natural radioactivity, modes of decay, decay constant, half life period, average life, radioactive equilibrium, Geiger-Nuttal rule, units of radioactivity, radiation dosage.

Induced radioactivity, nuclear reactions induced by charged projectiles, neutrons and γ rays fission reactions, fusion reactions, spallation reactions, preparation of

transuranic elements, Q values of nuclear reactions. Fertile and fissile isotopes, chain reaction, stellar energy.

References

1. B.R.Puri, L.R.Sharma, Kalia Principles of Inorganic Chemsitry, Milestone Publishers, New Delhi (Chapter 38).
2. H.J.Arnikar, Essentials of Nuclear Chemistry, New Age International (Chapter 3 –5).
3. R.Gopalan, Elements of Nuclear Chemistry, Vikas, Publ. House.

Further Reading

1. J.E.Huheey, E.A.Keiter, R.L.Keiter, Inorganic Chemistry, 4th edn., Harper Collins, 1993.
2. G.Wulfsberg, Inorganic Chemistry, Viva Books.
3. W.L.Jolly, Inorganic Chemistry, Ttata Mc Graw Hill.
4. J.D.Lee, New Concise Inorganic Chemistry.
5. M.N.Greenwood and A.Earnshaw, Chemistry of the elements 2nd edn., Butterworth.
6. Manas Chanda, Atomic structure and chemical bonding.
7. H.J.Emeleus, A.G.Sharpe, Modern Aspects of Inorganic Chemistry, Universal Book Stall.
8. J.David Brown, the Chemical Bond in Inorganic Chemistry, Oxford Science Publication.

3B04 CHE Inorganic Chemistry I

Credit – 3
Contact hours – 54

Module 1. Periodic Properties

Long form of the periodic table – periods and groups – Periodic table and electronic configuration – Division in to s, p, d and f blocks.

Periodic properties – Effective nuclear charge – Screening constant – Evaluation using stater rules – Definition, factors, influencing and periodic trends in

ionization energy, electron affinity and electro negativity (Pauling and Mullickan scab) – Atomic and ionic radii. **(4 hrs)**

Module 2.Chemistry of 's' block elements

2.1 Hydrogen : Isotopes (separation method not needed). Ortho and parahydrogen – Hydrieds and their classification.

2.2 Alkali and alkaline earth metals :

Occurrence and extraction (principle only). Comparative study based on electronic configuration and periodic properties of hydrieds, oxides, halides, nitrides, carbides, hydrxides, carbonates and sulphates (Preparation and chemical properties of these compounds not needed). Metal solutions in liquid ammonia – characteristic properties and uses. Diagonal relationship. **(5 hrs)**

Module 3. Chemistry of p-block elements

3.1 Occurrence and isolation of elements (principle only) – allotropy – Comparative study based on electronic configuration and periodic properties of binary compounds (hydrides, oxides, halides, carbides and sulphides) and oxyacids, relative stability of valencigs in these compounds, inert pair effect, metallic and non-metallic character, acid-base properties of oxides, hydrolysis of halides and exceptional behaviour of second period element in the following groups of elements – Group 13, (B, Al, Ga, In and Tl, Group 14 (C, Si, Ge, Sn and Pb) Group 15 (N, P, As, Sb and Bi) Group 16 (O, S, Se, Te and Po) and Group 17 (F, d, Br and I). **(14 hrs)**

3.2 Noble gases : Electronic configuration and position in the periodic table –

Occurrence – Noble gas chemistry – clath rates and compounds of Xenon; XeF_2, XeF_4, XeF_6, XeO_2F_2, $XeOF_2$, XeO_5, XeO_4 and XeO_6^{4-}. Preparation, use β (of elements and compounds), hybridization and geometry of these compounds. **(3 hrs)**

Module 4.Co-ordination Chemistry:

Introduction – Double salt and Co-ordination compounds – Werner's Co-ordination theory, Nomenclature – Isomerism – types of ligands – Electronic interpretation of Werner's theory – EAN rule.

Modern theories of M-L bond – valence bond theory – hybridization in tetrahedral, square planar and octahedral complexes – explanation of magnetic properties based on VBT. Crystal field theory, Crystal field splitting ion

octahedral, tetrahedral and square planar geometries. Explanation of spectral and magnetic properties –Spectro chemical series.

Stability of complexes – Kinetic and thermo dynamic stability – chelate effect.

Application complex formation in qualitative and quantitative analysis. **(12 hrs)**

Module 5.Organometallic Compounds :

Introduction – classification based on metal carbon bond. Metal carbonyls – preparation, properties structure and uses of mononuclear (Ni, Fe, Mn) binuclear (Fe, Mn, Co) and trinuclear (Fe) metallic carbonyl. Application of $18e^-$ rule to predict M-M bond.

Preparation properties structure and bonding in ferrocene. **(6 hrs)**

Module 6.Analytical Chemistry : Errors in Quantitative analysis – classification and minimization of errors.Accuracy and precision.

Principles of Chromatographic separations – Types of Chromatography – adsorption, partition and ion exchange chromatography – chromatographic techniques – Thin layer colum and paper chromatography – Gas chromatography.

Theory of titrations – acid base titration, redox titration, precipitation titration and complexometric titration – Indicators acid-base, redox and metal – ion indicators.

Gravimetric analysis – Solubility product – factors affecting solubilities of precipitates – Co-precipitation and post precipitation – errors due to precipitation.

(12 hrs)

References

1. Advanced Inorganic Chemistry - Cotton and Wilkinson
2. Concise Inorganic Chemistry - J.D.Lee
3. Modern approach to Inorganic chemistry – Bell and Lott
4. University General Chemistry - CNR Rao
5. Theoretical Inorganic Chemistry – J.Huhey
6. Industries in Kerala - K.R.Rajan
7. Principles of Inorganic Chemistry – Emelns and Anderson
8. Advanced Inorganic Chemistry - S.K.Agarwala and Keemitilal

4B06CHE Inorganic Chemistry II

Credits -3

Contact Hours-54

Module 1.Metallurgy: Occurrence of metals – minerals and ores – classification

(8 hrs)

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

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

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

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

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

Module 2. Bioinorganic Chemistry : **(6 hrs)**

Metal ions present in the biological system – metal ion deficiency and excess and diseases related to them – metal ion toxicity (Pd, Cd, As and Hg).

Structure and functions of haemoglobin and myoglobin. Metal ion transport across cell membrane – Na/k pump.

Biochemistry of Mg and Ca. Metallo enzymes of iron and zinc (structural details not needed).

Module 3. Transition elements : **(14 hrs)**

Position in the periodic table. General properties – electronic configuration, Oxidation states, spectra magnetic properties, tendency to form complexes and catalytic properties, tendency to form alloys and formation of non-stoichiometric compounds – Comparison of first transition series with second and third series.

Module 4. Inner transition elements **(12 hrs)**

Lanthanides – Occurrence and separation by ion – exchange chromatography. Electronic configuration, oxidation states, magnetic properties and spectra of lanthanide – Lanthanide contraction – causes and consequences.

Actinides : Electronic configuration, Oxidation states spectra and magnetic properties.

Trans actinide elements – Preparation, IUPAC nomenclature.

Comparison of transition and inner transition elements.

Module 5. **Industrial Chemistry** : (**6 hrs)**

Chemical Industries in Kerala – Sugar, alcohol, FiO_2, glass, cement, HCl, H_2So_4, NaOH, Urea, Ammonium phosphates and Super phosphate of lime (Location, raw materials, Chemistry involved in the preparation and uses)

Module 6. **Preparation, properties structure and uses of some inorganic compounds**. (**8 hrs)**

Hydrides of boron – B_2H_6 and B_4H_{10}, borazine, boric acid, oxy acids of halogens, Inter halogen compounds, Psuedo halogens, Fluorocarbons, Inorganic polyemers– silicons, silicates, polyphosphates and polyphosphazenes.

References

1. Advanced Inorganic Chemistry - Cotton and Wilkinson
2. Concise Inorganic Chemistry - J.D.Lee
3. Modern approach to Inorganic chemistry – Bell and Lott
4. University General Chemistry - CNR Rao
5. Theoretical Inorganic Chemistry – J.Huhey
6. Industries in Kerala - K.R.Rajan
7. Principles of Inorganic Chemistry – Emelns and Anderson
8. Advanced Inorganic Chemistry - S.K.Agarwala and Keemitilal

5B07CHE Physical Chemistry - 1

Credits 4

Contact hrs 90

Module 1 The Properties of Gases (15 hrs)

Gas laws – The general gas equation – Mixture of gases – Dalton's Law – Mole fraction and partial pressure – calculation of partial pressure – The Kinetic model of gases – Molecular Speeds – Maxwell's distribution of molecular speeds – Calculation of most probable velocity, average velocity and root mean square velocity – Average kinetic energy – Collision diameter – Mean free path, Collision number and collision frequency – Degrees of freedom of a gaseous molecule – Principle of equipartition of energy and contribution towards heat capacity of an ideal gas.

Real gases – Molecular attractions – The compression factor – virial equation of state – Van der waals equation expressed in virial form – calculation of Boyl's temperature – Isotherm of real gases and their comparison with Van der waals isotherms – continuity of states – critical phenomenon – critical constants of a gas and its determination – Determination of molecular mass by limiting density method – Principle of corresponding states – Liquefaction of gases by Joule Thomson effect and adiabatic demagnetization.

Module II Liquid State (10 hrs)

Theory of liquids – Vacancy theory and free volume theory – Properties of liquids – vapour pressure and its determination – Heat of vapourisation – Trouton's rule – Surface tension and its determination – Interfacial tension – surface active agents – Parachor and its applications – Viscosity and its determination – refractive index – specific and molar refraction – Measurement of refractive index – Abbe's refractometer – optical activity and its measurement using Polarimeter.

Module III Solid State (15 hrs)

Amorphous and crystalline solids – Laws of crystallography – Crystal lattices – Unit cells – seven crystallographic systems – Bravais lattices – Spacing of lattice planes in simple cubic, body centred and face centred cubic systems – Number of particles per unit cell in each of these - Calculation of Avogadro number, density and molecular mass from crystallographic data.

Determination of internal structure of crystals by X-ray diffraction methods – derivation of Bragg's equation – Bragg's rotating crystal method and De bye Scherrer Powder diffraction method – Crystal structure of NaCl – anomalous nature of diffraction pattern of KCl – Co-ordination Number – Efficiency of packing – Cubic and Hexagonal packing – Radius ratio rule – Tetrahedral and Octahedral voids.

Classification based on cohesive forces in crystals-ionic, covalent, molecular and metallic crystals – Liquid crystals – types – Examples – applications – Properties of solids – Mechanical, Rheological and elastic – Electrical conductivity – Conductor, semiconductors – extrinsic, intrinsic-n-type and p-type – Hall effect – super conductors – magnetic properties of solids.

Module IV Thermodynamics (25 hrs)

The first Law – the basic concepts – System – surrounding – process – open, closed and isolated system – Isothermal, Isochoric and Isobaric process – work – Heat – Energy – Internal energy – The statement of first law – the conservation of energy – Expansion work – general expression of work – free expansion – Expansion against constant pressure – reversible expansion – Heat capacity at constant volume (Cv) and at constant pressure (Cp) – relation between Cp and Cv – Thermodynamic derivation – Enthalpy definition and measurement – Adiabatic change – work of adiabatic change.

Thermo chemistry – Standard enthalpy changes – Enthalpies of physical change – Enthalpy of vapourisation, enthalpy of transition and enthalpy of fusion – enthalpy chemical changes – Thermo chemical equation – Standard enthalpy of reaction, combustion and formation – Temperature dependence of reaction enthalpies Kirchoff's law.

The First Law – State functions and exact differentials – state and path functions – exact and inexact different differentials – internal pressure – measurement of internal pressure – Joule experiment Changes in enthalpy at constant volume – isothermal compressibility – Joule – Thomson effect – inversion temperature. (15 hrs)

The Second Law – the concepts – Spontaneous and non-spontaneous process – statement of second law – Entropy – Thermodynamic definition – Entropy as a state function – Carnot cycle – the Thermodynamic scale of temperature – Entropy changes accompanying phase transitions – variation of entropy with temperature – the Helmholtz and Gibbs free energies – their significance – Maxwell's relations – Criteria of

spontaneity – Gibbs – Duhem equation – Clausius – Clapyeyron equation applicable to solid – liquid, solid-vapour and liquid-vapour equilibria.

Third Law of thermodynamics – The Nernst heat theorem – Absolute entropy – Calculation of absolute entropies of solids, liquids and gases. **(10 hrs)**

Module V Chemical Equilibrium (10 hrs)

Derivation of law of mass action from kinetic theory and thermodynamics – Experimental verification – Free energy change of chemical reactions – reaction isotherm – Van't Hoff isochore – standard free energy of reaction and equilibrium constant – Predicting the influence of temperature, pressure, concentration changes and addition of an inert gas on the equilibria of the following reactions.

1. $H_{2\,(g)} + I_{2\,(g)} \rightarrow 2HI_{(g)}$
2. $N_{2\,(g)} + 3H_{2\,(g)} \rightarrow 2NH_{3\,(g)}$
3. $N_{2\,(g)} + O_{2\,(g)} \rightarrow 2NO_{(g)}$
4. $2SO_{2\,(g)} + O_{2\,(g)} \rightarrow 2SO_{3\,(g)}$
5. $PCl_{5\,(g)} \rightarrow PCl_{3\,(g)} + Cl_{2\,(g)}$
6. $N_2O_{4\,(g)} \rightarrow 2NO_{2\,(g)}$
7. $CaCO_{3\,(s)} \rightarrow CaO_{(s)} + CO_{2\,(g)}$
8. $NH_4HS_{(g)} \rightarrow NH_{3\,(g)} + H_2S_{(g)}$

Principle of mobile equilibrium – Le-Chatliers Principle and application to the above equilibria – Degree of dissociation and dissociation constant from density measurements – Mention homogeneous and heterogeneous equilibria.

Module VI Chemical Kinetics (10 hrs)

The rates of chemical reactions – Experimental techniques – rate laws and rate constant – Order and molecularity of reactions – Methods of determining the rate of reaction – Integrated rate laws of first order, second order and third order reactions – Half life – kinetics of consecutive parallel and opposing reactions (first order only).

Temperature dependence of reaction rates – Arrhenius equation – derivation-Interpretation of parameters – Kinetics of unimolecular reactions – steady state approximation – Lindemann's theory.

Theories of reaction rates – collision theory – Derivation of rate equation for second order reaction from collision theory – thermodynamic approach of transition state theory – Entropy activation.

Catalysis – Homogeneous and Heterogeneous catalysis – examples – Features of homogeneous catalysis – Enzymes – Michalis – menten mechanism.

Hetyerogenous catalysis – Langmuir – Hinshelwood mechanism – Kinetics of surface reactions – unimolecular and bimolecular.

Module VII Photo Chemistry (5 hrs)

Photochemistry – consequences of light absorption – The Jablonski diagrams – Radiative and non radiative transition – Light absorption by solutions – Lambert – Beer Law – Laws of photochemistry – The Grotthus – Draper law – Stark – Einstein law – Quantum efficiency – Quantum yield – Experimental determination of quantum yield – Photochemical rate law – Energy transfer in photochemical reactions – Photo sensitisation and quenching – Chemiluminescence – Lasers – uses.

REFERENCE BOOKS

1. Atkin's Physical Chemistry : Peter Atkins, Julio de paula 7th Edition
2. Text book of Physical Chemistry : Samuel Glasstone
3. Physical Chemistry : GM Barrow
4. Physical Chemistry : Daniel and Alberty
5. Physical Chemistry : Puri, Sharma and Pathania
6. Physical Chemistry : WJ Moose
7. Physical Chemistry : G K Vamulapaki
8. Introduction to Chemical Thermodynamics : Rastogi and Misra
9. Chemical Kinetics : K.J.Laidler
10. Physical Chemistry : PC Rakshit
11. Physical Chemistry : Glasstone & Lewis

5B08 CHE PHYSICAL METHODS IN CHEMISTRY

Contact hours-74

Credits-4

Module –1 Spectroscopy (30 Hours)

Electromagnetic Spectrum – Ranges of different radiation, General features of Spectroscopy.

Microwave Spectroscopy – Rotation spectra, Moment of inertia, Rotational Quantum numbers, Rotational Constant, Intensities of rotational spectral lines, Rotational – Vibrational Spectrum of diatomic molecules – Selection rules for rotational spectra.

Infrared Spectroscopy – Theory of infrared spectra, Sampling techniques, Selection rule, Molecular vibration – Stretching and Bending modes, Calculation of stretching frequencies – Fundamental Bands and Overtones, Factors influencing vibrational frequency – Electronic effects, hydrogen bonding, solvent effect etc. Applications of IR Spectroscopy – Interpretations of the spectra of alcohols, aldehydes, ketones and esters – aliphatic and aromatic.

Raman Spectroscopy – Theory , Stokes and Anti-Stokes lines, Selection Rules.

UV Spectroscopy - Absorption laws, Selection Rules – Types, Electronic transitions – Position and Intensity of absorption, Molar extinction coefficient, Chromophore – Auxochrome Concept, Absorption and Intensity Shifts, Types of Absorption Bands, Interpretations of spectra of simple conjugated dienes and enons, Woodward-Fieser Rule, Application to dienes and enons.

NMR Spectroscopy - Introduction, Theory of NMR, Phenomena of resonance, Modes of nuclear spin-Relaxation Process, Chemical Shift – Internal standard, δ and τ scale, Shielding Effects, Factors affecting Chemical Shift, Spin-Spin Coupling, Interpretations of spectra of hydrocarbons, alcohols, aldehydes, ketones, aliphatic and aromatic compounds.

Mass Spectrometry – Basic principles, Instrumentation, Fragmentation pathway, Molecular ion-base peak, Meta stable ion, General rules for predicting the prominent peaks, Mc-Lefferty Rearrangement, Mass spectra of alkanes, cyclo alkanes, saturates alcohols and aliphatic ketones.

Module -II Instrumental Methods (25 hours)

Polarography : Dropping Mercury Electrode, Polarization – Concentration polarization, Half wave Potential and Diffusion current (Significance), Illkovic equation, Advantages of polarographic analysis – Applications.

Amperometry : Amperometric Titrations, Indicators, Instrumentation-Procedure, Biamperometric Titrations – Advantages and disadvantages, Applications.

Chromatography : Types of Chromatography (brief study) – Adsorption and Partition Chromatography, Thin Layer Chromatography – R_f value, HPLC, Ion Exchange Chromatography – Applications.

Thermal methods of Analysis : Thermogravimetric analysis (TGA), Derivative Thermogravimetry (DTG) and Differential Thermal analysis (DTA) – Instrumentation, Application and Characterization of polymers.

Atomic Absorption Spectroscopy : Flame Atomization and Flame Structure – Hollow Cathode lamp, Interference.

Atomic Emission Spectroscopy : Direct current plasma source – Analyte atomizatio and ionization – instrumentation (brief) – Applications.

Inorganic applications :

Spectrophotometry : Colorimetric Methods – Theory and Applications

Magnetic Properties : Types of magnetism – paramagnetism, diamagnetism and ferromagnetism Curies law, Weiss's law, Spin only Value, Magnetic Properties of the complexes on the basis of VBT.

Electronic Spectra : Crystal Field Splitting in octahedral and tetrahedral complexes – d-d transition, Spectrochemical series, Explanation of the color of complexes.

Module -III Concepts and Applications of Nano Science (8 hours)

Introduction - What is Nano Science and Nano technology – Quantum Size Effect – Single electron Tunneling, Preparation, Properties and applications. Nano technology in Bio-engineering.

Module – IV Computational Chemistry (9 hours)

Introduction – Methods of calculation – molecular mechanics – Quantum mechanical methods – HF-DFT Method (Qualitative treatment only), Basic functions, Slaters type Orbitals, Gaussian type Orbitals, Z Matrix of H_2O and ammonia.

REFERENCE BOOKS

1. Applications of Absorption Spectroscopy of Organic Compounds - Dyer
2. Introduction to Molecular Spectroscopy - Barrow
3. Spectroscopy of Organic Compounds – P.S.Kalsi
4. Organic Spectroscopy – William Kemp
5. Molecular Spectroscopy - Banwell
6. Polarography and Allied Techniques – V.Suryanarayana Rao
7. Instrumental Methods of Chemical Analysis – B.K.Sharma
8. Computational Chemistry - Grand
9. Instrumental Methods of Chemical Analysis – Skoog and West
10. Nano technology – Richard Brooker, EARL Boyson – Wiley Dream Tech India.
11. Nano technology (Malayalam) – Anwar Sadath – DC Books
12. www.nanoworldorg., www.Nanoindustries.com

5B09 CHE Organic Chemistry – I

Contact hours-72

Credits-4

Module 1 : Introduction to Organic Chemistry (5 Hours):

Difference between Organic and Inorganic compounds, Functional groups and homologous series, IUPAC nomenclature of alkanes, cyclo alkanes, alkens, alkynes, Halogen compounds, alcohols, ethers aldehydes, ketones, carboxylic acids, nitro compounds, nitriles amines and bifunctional compounds.

Module 2: Hydrocarbons (15 hrs)

Alkanes – preparation by reduction of alkyl halides – Wurtz reaction and Kolbe's electrolytic methods with mechanism - Chlorination of methane with mechanism.

Alkenes – preparation by dehydration of alcohols, dehydrohalogenation of alkylhalides, dehalogenation of vicdihalides and by Kolbe's electrolytic method. Reaction – Hydrogenation, addition of halogens, halogen acid and water. Oxidation with $KMnO_4$, $K_2Cr_2O_7$ and osmium tetroxide, Ozonolysis and polymerization.

Alkynes – Preparation by dehydrohalogenation of vicdihalides and gem dihalides, dehalogenation of tetrahalides and Kolbe's electrolytic method. Reactions, addition of Hydrogen, Halogen, Halogen acid and water – oxidation using alkaline $KMnO_4$, Acidic $K_2Cr_2O_7$ and Selenium dioxide. Ozonolysis and Polymerization reactions, Specific to 1-alkyne.

Dienes – Conjugated, cumulated and isolated dienes with example, preparation of 1, 3 butadiene. By dehydration of diols, reaction of 1, 3 butadiene – Diels-Alder reaction, polymerization.

Poly nuclear Hydro carbons Synthesis of naphthalene by Haworth synthesis of Anthracene from benzyl chloride.

Cyclo Alkane – preparation by Freunds and Wislicenus.

Module 3: Reaction intermediates and electron displacement effects (9 hrs)

Homolytic and Heterolytic Bond Fission – Substrate and Reagent – Electrophiles and Nucleophiles – Reaction intermediates – carbocation, carbonion, Free radicals and Carbenes – Their generation, structure and stability – Electron displacement effects – Inductive effect, Electrometric effect, Mesomeric effect, Hyper conjugation effect and Sterric effect – Their application.

Module 4 : Mechanism of Organic reactions (10 Hours) :

Nucleophilic Substitution in alkyl halides – SN1 and SN2 mechanism – Effect of structure on SN1 and SN2 as illustrated by Primary, Secondary and Tertiary alkyl halides and Benzyl halides – Stereo Chemistry of SN1 and SN2 reaction – Mechanism of Electrophilic addition of Hydrogen halides to Carbon – Carbon double bond. Markownikoff's rule – Peroxide effect (Free radical addition of HBr on unsymmetrical double bond. Elimination – E1 and E2 mechanism – mechanism of dehydration of alcohol and dehydrohalogenation of alkyl halides – Saytzef's rule and Hofmann's rule.

Module 5 (10 hrs)

Aromaticity : Huckel's rule and molecular orbital theory of aromaticity – mention of structures of the following non-benzenoid aromatic compound – cyclopentadienyl anion, Ferrocene and tropylium, cation – Antiaromaticity, mechanism of the following aromatic electrophilic Substitution. Halogenation, Nitration, Sulphonation, Friedal Craft's alkylation and acylation – Aromatic nucleophilic substitution – SN Ar and Benzyne Mechanism.

Module 6 : Halogen Compound (8 hrs)

Alkyle halides – preparation form alcohol – Reaction of alkyl halides with metal Dihalides – Gem dihalides and Vic dihalides – General methods of preparation – General reaction – Trihalogen derivative of methane – Chloroform – preparation from ethanol and acetone – Haloform reaction.

Module 7 : Stereo Chemistry (15 hrs)

Classification of Stereo isomers – Geometrical isomers – Cis-trans, E-Z designation – characterization of geometrical isomers – conformation of ethane, n-butane and Cyclohexane Configuration – Wedge formula and Fischer projection formula – Newmann projection formula. Optical isomerism plane polarized light – chirality and elements of symmetry. DL designation and RS designation, Enantiomers, mesoform, erythro and threo forms and diastereoisomers.

Reference

1.Organic Chemistry : I.L. Finar Volume 1 and II
2.Organic Chemistry : Pine
3.Advanced Organic Chemistry : Bhal and Bhal
4.A Text Book of Organic Chemistry : Tewari, Mehrothra, Vishnoi
5.Advanced Organic Chemistry : Jerry March
6.A Guide to mechanism in Organic Chemistry : Peter Sykes
7.Organic reaction mechanism : Raj K Bewsal

6B13CHE PHYSICAL CHEMISTRY II

Contact hours-90

Credits-4

Module I Symmetry and Molecular Structure (6 hrs)

Elements of symmetry of molecules – Centre of symmetry, plane of symmetry, proper and improper axis of symmetry – Operations with examples – Point groups – Properties of a group – simple point groups Cnv, Cnh.

Module II Dilute Solutions (10 hrs)

Colligative properties – Lowering of vapour pressure and Raoult's law – Calculation of molar mass. Elevation of boiling point – relation to lowering of vapour pressure – Thermodynamic derivation – Calculation of molar mass – Measurement by Beckmann's and Landsberger's methods – Depression of freezing point – Thermodynamic derivation – Calculation of molar mass – Measurement by Beckmann's method – Osmotic pressure – Measurement by Berkely and Hartley's method – Laws of Osmotic pressure – Van't Hoff equation – Calculation of molar mass – Abnormal molar mass – Van't Hoff factor – Degree of dissociation and association and their calculation from colligative properties.

Module III Phase Rule (15 hrs)

Statement – Explanation of terms involved – Thermodynamic derivation of phase rule – Application to water system and sulphur system – Solid – liquid equilibria involving simple eutectic system – Ag-Pb system – De silverisation of lead – Freezing mixtures – Solid – liquid equilibria involving compound formation with congruent and incongruent melting points – Solid – gas system – Dehydration of CuSO4.5 H_2O- Deliquescence and efflorescence – Gas Liquid system – Absorption coefficient – Henry's Law – Liquid systems – Completely miscible – Ideal and non-ideal solutions – Application of Raoult's Law – Vapour pressure – composition from Raoult's Law Azeotropic mixtures – Partially miscible liquids – Critical solution temperature – Temperature – composition curves – Fractional distillation – Derivation from Raoult's Law – Immiscible liquids – Steam distillation – Molar mass from steam distillation – Nernst distribution Law – Derivation from phase rule and thermodynamics – Limitations of the law – Application of the law to study association and dissociation – Solvent extraction – Hydrolysis of salts – The equilibrium of $KI + I_2 \rightarrow KI_3$

Module IV Colloids, Surface Chemistry (10 hrs)

Colloids, Classification – preparation – structure and stability – The electrical double layer – Zeta potential – Properties of Colloids – Tyndall effect – Brownian movement – Coagulation of colloidal solution – Hardy – Shulz rule – Flocculation value – Electro kinetic properties – Electrophoresis – Electro-osmosis – Protective colloids – Gold number – Emulsion – Oil in water emulsion and water in oil emulsion – Emulsifying agents – Gels – Inbibition – Synerisis – Micelles – Critical micelle concentration – surface films – Physisorption and Chemisor Adsorption isotherms – Freundlich adsorption isotherm – effect of temperature on adsorption – Langmuir adsorption isotherm – derivation – use and limitation.

Module V Electrical Conductance (15 hrs)

Ohm's Law – Electrical energy – volt – coulomb – Mechanism of electrical conduction – Arrhenius theory – The laws of electrolysis – Faraday's law and its significance – Transference Number – Determination by Hittorf's method and moving boundary method.

Equivalent conductance and Molar conductance Effect of Dilution on conductance – Effect of dielectric constants of solvents – Ionic mobilities – Kohlrausch's

Law – applications – Mobilities of Hydrogen and Hydroxyl ions – Diffusion and ionic mobility.

Activity and activity coefficient – standard state ionic activities and activity coefficient – ionic strength – Debye – Huckel Theory – Ionic atmosphere – Debye – Huckel limiting law – determination of solubilities by conductance measurements – conductometric titrations – conductance in non-aqueous solvents – Temperature dependence of ionic conductance.

Module VI Ionic Equilibria (14 hrs)

Acids and bases – Lowrry – Bronsted concept – Dissociation of acids and bases – Lewis concept of acids and bases – hard and soft acids and bases and its applications – Ionic product of water – Dissociation constants of acids and bases – pH and its determination – Heat of neutralization – Incomplete neutralization – Hydrolysis of different types of salts – Degree of hydrolysis and hydrolytic constant – and its relation with pH and pOH – Buffer solution – pH of Buffer solution – Henderson's equation – Buffer capacity – Application of buffer – Acid – base indicators – Determination of pH of indicators.

Module VII Electromotive Force (20 hrs)

Electrochemical cell-Daniell cell – Reversible and Irreversible cell – Single electrode potential – EMF of cells – Standard potential and standard emf – Standard Hydrogen electrode and calomel electrode – Types of electrodes – electrode reaction – cell reaction Nernst equation for electrode potential and emf of the cell – Electrochemical series – IUPAC sign convention – Application of Gibb's Helmholtz equation to galvanic cells – Calculation of ΔG, ΔH, ΔS and equilibrium constant from emf data – The standard cells – Weston Cadmium cell and its emf.

Concentration cells – Electrode and electrolytic concentration cells with and without transference and their emfs – Liquid junction potential – Elimination of liquid junction potential – salt bridge – application of potential measurements – Determination of solubility product, ionic product of water, transport number and the pH value – Hydrogen, Quinhydrone electrode and glass electrode – potentiometric titration – redox

indicators – Polarisation – Over voltage – principle and applications of polorography – Fuel cells.

REFERENCE BOOKS

1. Text Book of Physical Chemistry : Glasstone
2. Atkin's Physical Chemistry : Peter Atkins Julio de Paula VII Edn.
3. Modern Electro Chemistry : JOM Bockris & AKN Reddy
4. Physical Chemistry : Puri Sharma and Pathania
5. Physical Chemistry : P.C.Rakshit
6. Physical Chemistry : Walter J Moore
7. Vogel's Text Book of Qualitative Inorganic Analysis : AI Vogel
8. Physical Chemistry : Gillbert Casillane
9. Physical Chemistry : GK Vemulapalli
10. Physical Chemistry : Gurdeepraj
11. Prgathi's Instrumental Methods of analysis : H Kaur
12. Group Theory in Chemistry : V.Ramakrishnan

6B14 CHE Organic Chemistry-II

Contact hrs-72

Credits-4

Module-I, Hydroxy Compounds (7 Hours)

Alcohols – Preparation of monohydric alcohols from carbonyl compounds using Grignard reagents – Methods to distinguish 1^o, 2^o and 3^o alcohols – Lucas method, Victor Meyer's method and oxidation method – Ascent and descent in alcohol series.

Glycerol – Manufacture from fats and oils – Synthesis from propylene – Properties and uses .

Phenols – Preparation of phenol from cumene – Acidic character of phenol – Preparation of cresols, nitrophenols, picric acid, dihydric phenols and naphthols – Phenolic ethers – Preparation of anisole and phenetole.

Mechanism of the following rearrangements – Pinacol – Pinacolone, Fries and Claisen rearrangements.

Module – II, Carbonyl Compounds (11 Hours)

Preparation of aldehydes and ketones – Rosenmund's reduction, Stephen's reduction, Etard's reaction, Oppeanauer oxidation, Houben – Hoesh synthesis. Reactions of aldehydes and ketones. Reduction using $LiA1H_4$ and $NaBH_4$ MPV, Clemensen and Wolf-Kishner reduction. Reduction to pinacols – Oxidation using mild and strong oxidizing agents – SeO_2 oxidation – Reaction with alcohols, KCN, sodium bisulphate and derivatives of ammonia – Distinction between acetaldehyde and benzaldehyde and acetaldehyde and acetone.

Mechanism of the following reactions – Aldol condensation , Cannizzaro's reaction, Crossed Cannizzaro's reaction, Reimer – Tiemann reaction, Perkin's reaction, Benzoin condensation and Backmann rearrangement. Reaction of formal- dehyde with aldehydes containing alpha hydrogen atoms.

Preparation of acrolein, crotonaldehyde and vanillin.

Quinones – Preparation and important reactions of p-benzoquinone, 1, 4 – Naphthaquinone and 9, 10 – Anthraquione.

Module – III, Carboxylic Acids, Sulphonic acids and Amino acids (14 Hours)

Carboxylic acids – Ascent and descent in aliphatic acid series, Preparation and reactions of acrylic and crotonic acids.

Hydroxy acids – Effect of heat on alpha, beta, gamma and delta hydroxyl acids – Preparation and reactions of lactic acid, tartaric acid and citric acid.

Dicarboxylic acids – Preparation and reactions of oxalic, malonic, succinic, maleic and fumeric acids – Blanc's rule.

Aromatic acids – Preparation and reactions of Benzoic acids, anthranilic acid, salicylic acid, cinnamic acid and phthalic acid.

Aromatic sulphonic acids – Preparation and reactions of benzenze sulphonic acid, toluene sulphonic acids, benzenze sulphonyl chloride, ortho and para toluene sulphonyl chlorides – Preparation and uses of sccharin and chloramines-T. Preparation and properties of sulphanilic acid and sulphanilamide – Sulpha drugs – examples and uses.

Amino acids, Protiens and Nucleic acids – Classification of amino acids – Structure of glycine, alanine, phenyl alanine, tryptophan, cystine and glutamic acid (structural elucidation not expected) – Synthesis of amino acids – Gabriel, Strecker and Erlenmeyer synthesis – Zwitter ion property – Isoelectric point – Sorensen formal titration.

Module – IV, Synthetic Reagents (5 Hours)

Active methylene group – Preparation and synthetic applications of Ethyl acetoacetate, Diethyl malonate and ethil cyanoacetate. Mechanism of Claisen condensation. Preparation and synthetic uses of Grignard reagent and Frankland reagent – Mechanism of Reformatsky reaction.

Module – V, Nitrogen Compounds (12 Hours)

Cyanides and Isocyanides – Distinction between cyanides and isocyanides. Nitroalkanes – General methods of preparation and reactions of primary, secondary and tertiary nitroalkanes. Distinction between primary, secondary and tertiary nitroalkanes. Aromatic nitrocompounds – Reduction of nitrobenzene under different conditions – Preparation of dinitrobenzene, 1, 3, 5 – trinitrobenzene, nitrotoluenes and 2, 4, 6 – trinitrotoluene – Mechanism of Benzidine rearrangement.

Amines – Separation of primary, secondary and tertiary amines – Hinsberg and Hoffmann method to distinguish primary, secondary and tertiary amines. Preparation of quaternary ammonium salts.

Aromatic amines – Preparation and reactions of aniline, toluidines, phenylene diamines, diphenyl amine, N-Methyl aniline, N, N-dimethyl aniline and naphthyl amines. Distinction between benzyl amine and toluidine.

Diazonium salts – Preparation, synthetic applications and structure of benzene diazonium chloride, Diazomethane and diazoacetic ester-Ardnt-Eistert synthesis – Wolf rearrangement – mechanism.

Preparation, Properties and structure of urea, Preparation and reactions of semicarbazide and thiourea – Preparation of Urethane.

Module – VI, Heterocyclic Compounds (6 Hours)

Nomenclature of 5 and 6 – membered heterocyclic compounds – Preparation, structure and properties of Pyrrole, Pyridine, Indole, quinoline Isoquinoline, Pyrimidine and Purine – Relative basic character of Pyrrole, Pyridine and Piperidine – Hoffmann's exhaustive methylation of piperidine and coniine.

Module – VII, Carbohydrates (10 Hours)

Classification and nomenclature of carbohydrates – Configurations of aldotrioses, teroses, pentoses and hexoses – Structure and configuration of glucose fructose-cyclic structure – Haworth projection formula – anomers – mutarotation – reactions of glucose and fructose - ascent and descent in aldoses – Interconversion of aldoses and ketoses – Epimer and Epimerisation – Conversion of an aldose into it's epimer – Disaccharides – Configurational open chain ring structure of sucrose, maltose and lactose (structure elucidation not expected) – Elementary study of starch and cellulose – Industrial uses of cellulose.

Module – VIII, Dyes (3 Hours)

Classification of dyes bases on structure and application – Synthesis and use of Parared, Malachite green, Fluorescein, Eosin, Crystal violet, Fuschine, Indigo and Alizarin (Structure elucidation not expected) – Relation between colour and constitution.

Module – IX, Polymer Chemistry (4 Hours)

Classification – Natural and synthetic polymers – Thermoplastics and thermosetting plastics – Elastomers – Fibres – Liquid resins – Types of polymerization – Chain and step polymerization – Homopolymers and Co-polymers – Synthesis and application of Polythylene, Polypropylene, PVC, Polystyrene, Polyurethanes, Phenolic and Epoxy resins – Synthetic rubber – Buna-S, Buna-Neoprene, and Butyl rubber-Biodegradability.

Reference

Organic Chemistry	:	I.L.Finar Volume I and II
Organic Chemistry	:	Pine
Advanced Organic Chemistry	:	Fieser and Fieser
Advanced Organic Chemistry	:	Bhal and Bhal

A Text Book of Organic Chemistry	:	Tewari, Mehrothra, Vishnoi
Advanced Organic Chemistry	:	Jerry March.

SYLLABUS OF B.Sc CHEMISTRY PRACTICAL

General Instructions

1. For weighing, both electronic balance and chemical balance may be used. (However, electronic balance is preferred).
2. Organic reactions may be carried out in tiles, wherever possible.
3. Reagents should be kept in small bottles with dropper.

4. Semi-micro method may be adopted for qualitative analysis.
5. Practical examination will be conducted in even semesters (ie. 2^{nd}, 4^{th} and 6^{th} Semesters).

CORE COURSE (1B02 CHE & 2B02 CHE) PRACTICAL (72 Hours, Credit 4)

Introduction to volumetric analysis

(i) Relation of acid-base titrations with real life situations like estimation of citric acid in lemon, orange etc.

(ii) Equivalent and molecular mass of compounds. Normality and Molarity – Primary standards. Preparation of standard solution – Principles of volumetric analysis.

(iii) For acidimetry, alkalimetry and permanganometry two burette method may be used and for other volumetric analyses conventional methods can be used.

1. **ACIDIMETRY AND ALKALIMETRY**
   a. Estimation of NaOH using standard $N_{a2}\ CO_3$ (two burette method).
   b. Estimation of HCl using standard oxalic acid (two burette method).
   c. Estimation of bicarbonate and carbonate in a mixture.
2. **PERMANGANOMETRY**
   a. Estimation of oxalic acid – using standard Mohr's salt (Two burette method).
   b. Estimation of Fe^{2+} using standard oxalic acid (two burette method).
   c. Estimation of Ca^{2+}
   d. Estimation of nitrite.
   e. Estimation of percentage of Mn in pyrolusite.
   f. Estimation of hydrogen peroxide.
3. **DICHROMETRY**
   a. Estimation of Fe^{2+} - External indicator.
   b. Estimation of Fe^{3+} - Reduction of $SnCl_2$-Internal indicator.
   c. Estimation of Fe^{2+} using internal indicator.
4. **IODOMETRY AND IODIMETRY**
   a. Estimation of $Cu^{2+}/CuSO_4.5H_2O$
   b. Estimation of Potassium dichromate/Cr^{3+}

c. Estimation of As_2O_3/As^{3+}

5. **PRECIPITATION TITRATION – using adsorption indicators**

   a. Estimation of chloride in neutral medium.

6. **COMPLEXOMETRY**

   a. Estimation of Mg^{2+}

   b. Estimation of Zn^{2+}

   c. Determination of total hardness of water

7. **PROJECT RELATED TO REAL LIFE SITUATIONS**

   a. Estimation of citric acid in lemon or orange.

   b. Rancidity of oils by iodometry.

VIVA VOCE

CORE COURSE (3B05 CHE & 4B05 CHE)

PRACTICAL

Contact Hours-72

Credit-2

PRACTICAL COURSE: INORGANIC QUALITATIVE ANALYSIS & PREPARATION (PART I & PART II)

(i) Systematic qualitative analysis of a mixture containing two cations and two anions by semi-micro method

Study of the reactions of the following ions with a view to their identification and confirmation – Lead, Silver, Mercurous mercury, Mercuric mercury, Bismuth, Copper, Tin, Antimony, Iron, Aluminium, Chromium, Zinc, Manganese, Cobalt, Nickel, Barium, Strontium, Calcium, Magnesium, and Ammonium.

Carbonate, Acetate, Oxalate, Fluoride, Chloride, Bromide, Iodide, Nitrate, Sulphate, Borate, Phosphate, Chromate, Arsenate, Arsenite.

Note : Minimum ten mixtures should be analyzed and recorded.

(ii) **Preparations** : Any three of the following inorganic preparations.

(1) Ferrous ammonium sulphate.

(2) Tetraammine copper (II) sulphate.

(3) Potassium trisoxalato chromate.

(4) Potash alum $KAl(SO_4)_2 . 12H_2O$

(5) Hexaammine cobalt (III) chloride.

CORE COURSE PRACTICAL

Contact Hours-360

Credit-10

5B10 CHE, 5B11 CHE, 6B10 CHE, 6B11 CHE, 6B16 CHE

SEMESTER V & VI PRACTICALS : GRAVIMETRIC ANALYSIS

Introduction to gravimetric techniques and its highlights.

1. Determination of water of hydration in crystalline barium sulphate.
2. Determination of Ba^{2+} as $BaSO_4$
3. Determination of sulphate as $BaSO_4$
4. Determination of Fe^{2+}) as Fe_2O_3
5. Determination of Ca^{2+} as $CaCO_3$
6. Estimation of Ni^{2+} as Nickel dimethylglyxomite.
7. Determination of Cu^{2+} as cuprous thiocyanate.
8. Determination of Mg^{2+} as magnesium oxinate.

SEMESTER V & VI PRACTICALS : ORGANIC CHEMISTRY

1. **Synthesis of Organic Compounds**.
   a. Aromatic electrophilic substitution:
      Nitration – Preparation of nitrobenzene and *p*-nitroacetanilide
      Halogenation – Preparation of *p*-bromoacetanilide, preparation of 2, 4, 6 – tribromophenol
   b. Diazotization and coupling : Preparation of phenyl azo β-naphthol and methyl orange.
   c. Oxidation : Preparation of benzoic acid from benzyl chloride or benzaldehyde .
   d. Esterification : Benzoylation of phenol to phenyl benzoate.
   e. Hydrolysis : Benzamide or ethylbenzoate to benzoic acid.
2. **Organic Qualitative Analysis**
   a. Qualitative analyses with a view to characterize functional group/groups in the following compounds:
      Napthalene, anthracene, chlorobenzene, bromobenzene, benzyl chloride, *p*-dichlorobenzene, benzyil alcohol, phenol, cresols, naphthols, resorcinol, benzaldehyde, acetophenone, benzophenone, benzoic acid, phthalic acid, cinnamic acid, succinic acid, salicylic acid, ethyl benzoate, methyl

salicylate, benzamide, urea, aniline, toludines, dimethyl aniline, nitrobenzene, *o*-nitrotoluene, glucose, sucrose.

b. Preparation of derivatives.

c. Separation of two component mixtures : Aniline + Naphthalene.

Note : Minimum ten compounds should be analyzed and recorded. For analysis, reactions may be carried out in tiles, wherever possible.

3. Thin layer Chromatography and Column Chromatography

a. Preparation of the TLC plates – Checking the purity of the compounds by TLC – Acetylation of salicylic acid, aniline, Benzoylation of aniline and phenol, Determination of R_f. Values and identification of organic compounds by TLC, preparation and separation of 2, 4 –dinitrophenyl hydrazones of acetone and 2-butanone using toluene and light petroleum (40 :60).

b. Separation of ortho and para nitroaniline mixture by column chromatography.

4. **Demonstration Experiments**

Steam distillation : Separation of ortho and para nitro phenols.

5. Structure elucidation of simple organic compounds from spectra (UV, NMR, IR and Mass)

Methyl ethyl ketone, Cumene, Ethylalcohol, Acetophenone, Propanoic acid, Anisole, Benzaldehyde, Phenol, Benzylalcohol, Phenetole, isopropylbromide

SEMESTER VI PRACTICAL : PHYSICAL CHEMISTRY

1. **Chemical Kinetics**

a. Determination of specific reaction rate of the hydrolysis of methyl acetate catalysed by hydrogen ion at room temperature.

b. Determination of overall order of saponification of ethyl acetate.

2. **Distribution law**

a. Determination of distribution coefficient of iodine between water and carbontetrachloride.

3. **Electrochemistry**

a. Determination of concentration of HCl conductometrically using standard NaOH solution.

b. Determination of concentration of acetic acid conductometrically using standard NaOH solution.

4. **pH metry**

   a. Preparation of alkaline buffer solutions.

   b. pH metric titration of weak acid (acetic acid) with strong base NaOH and calculation of dissociation constant.

5. **Colorimetry**

   a. Verificatin of Beer-Labert law for $KMnO_4$, $K_2CR_2O_7$ and determination of the concentration of the given solution.

6. **Adsorption**

   a. Adsorption of acetic acid, oxalic acid on animal charcoal, verification of Freundlich isotherm.

7. **Phase rule**

   a. CST of phenol – water system.

   b. Transition temperature of salt hydrates.

8. **Molecular weight determination**

   a. Determination of molecular weight by Rast's method – determination of identity of two compounds by mixed melting points.

VIVA VOCE

Viva voce examination based on practical will be conducted on 2nd day along with the practical examination.

STUDY TOUR

Students are required to visit at least one Laboratory/factory/Research Institute of eminence during the course and present the Study Tour Report separately along with Practical Records at the time of Practical Exam (6th Semester). A bonafide Certificate for the visit should be attached with the report.

REFERENCES

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

8. N.K.Vishnoi – Advanced Practical Chemistry.

MODEL QUESTION PAPERS FOR PRACTICALS

B.Sc CHEMISTRY PRACTICAL EXAMINATION
CORE COURSE PRACTICAL (1B2 CHE & 2B2 CHE)

SEMESTER II PRACTICAL COURSE : VOLUMETRIC ESTIMATION

Time : 4 Hours

Credit : 4

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

1. Write down the principle with equations for the estimation of ……...given ……

2. Calculate the weight of ……. Required for the preparation of ……N,……mL solution.

3. Estimate the amount of …….. in the whole of the given solution provided with …….solution and …….crystals.

4. Viva Voce

B.Sc CHEMISTRY PRACTICAL EXAMINATION

CORE COURSE PRACTICAL (3B5 CHE & 4B5 CHE)

SEMESTER IV PRACTICAL PAPER II : INORGANIC QUALITATIVE ANALYSIS AND PREPARATION

Time : 4 Hours

Credit: 2

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

1. Write briefly the principle of addition of HCl in the group II analysis/Role of addition of NH_4Cl in the group III analysis/Role of preparation of sodium carbonate extract in the analysis of anions.

2. Write the principle and procedure used in the preparation of ……..

3. Analyse systematically the given mixture containing the anions and cations by semi-micro method.

4. Exhibit at least 3 samples of the prepared inorganic compounds.

5. Viva Voce.

B.Sc CHEMISTRY PRACTICAL EXAMINATION
CORE COURSE PRACTICAL (5B10 CHE & 6B10 CHE)

SEMESTER VI PRACTICAL COURSE : GRAVIMETRIC ANALYSIS

Time : 3 Hours

Credit: 3

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

1. Write down the principle and procedure for the estimation of …….. in the given ……solution.

2. Estimate the amount of …… in the whole of the given …….. solution.

3. Viva Voce.

B.Sc CHEMISTRY PRACTICAL EXAMINATION
CORE COURSE PRACTICAL (5B11 CHE & 6B11 CHE)

SEMESTER VI PRACTICAL COURSE : ORGANIC CHEMISTRY

Time : 3 Hours

Credit : 3

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

1. Write down the principle for the estimation of ……..from……..

2. Analyse the given organic compound with a view to identify the nature of the functional group. Suggest a suitable solid derivative.

3. Analyse the given spectra and arrive at the correct structure of the compound.

4. Convert the given…….. into…….. Recrystallize and exhibit both crude and recrystallized samples.

5. Viva Voce.

B.Sc CHEMISTRY PRACTICAL EXAMINATION
CORE COURSE PRACTICAL (6B16 CHE)

SEMESTER VI PRACTICAL COURSE : PHYSICAL CHEMISTRY

Time : 4 Hours

Credit : 4

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

1. (a) Write down the principle adopted in the determination of concentration of HCl conductometrically.
   (b) Principle involved in the determination of concentration of $KMnO_4$ or $K_2Cr_2O_7$ by calorimetry.

2. Determine the molecular mass of the given compound by Rast's method.

3. Submit the Project Report.

4. Viva Voce

Sd/-
Dr.K.Pradeep Kumar,
Chairman,Board of Studies in Chemistry (UG)

KANNUR UNIVERSITY

SCHEME & SYLLABUS

CHEMISTRY (COMPLEMENTARY)

With effect from 2009 Admission

UNDER

CHOICE BASED CREDIT SEMESTER SYSTEM

SCHEME
COMPLEMENTARY (CHEMISTRY)

No	Semester	Course Code	Title of the course	Contact Hours/week	Credits
1	1	1CO1CHE	Chemistry(For Physical &Biological Sciences)	2	2
2	2	2CO2CHE	Chemistry(For Physical &Biological Sciences)	2	2
3	3	3CO3CHE	Chemistry(For Biological Sciences)	3	2
4	4	4CO4CHE	Chemistry(For Biological Sciences)	3	2
5	3	3CO5CHE	Chemistry(For Physical Sciences)	3	2
6	4	4CO6CHE	Chemistry(For Physical Sciences)	3	2
7	1,2,3,4	4CO7CHE	Chemistry Practicals	8	4

1C01CHE Chemistry

For Physical & Biological Sciences

Contact Hrs –36

Credit -2

Module I : Atomic Structure and Periodic Table (10 hrs)

Bohr atom Model (No derivation) – Atomic Spectra – limitations – wave mechanical concept of atom – Heisenberg's Uncertainty Principle – Duel nature of electrons – De Broglie equation – quantum numbers. Orbit and orbitals – Schrodinger equation (no derivation). The periodic table – periods and groups-s, p, d and f block elements – modern concept – periodic trends – atomic radii, ionic radii & covalent radii – effective nuclear charge and screening effect – Ionization potential – electro negativity and electron affinity.

Module II : Chemical bonding (10 hrs)

Ionic, covalent and co-ordinate bonds. Lattice energy of ionic compounds – Born Haber cycle. VSEPR theory and its applications. Shape of molecules CO_2, BeF_2, BF_3, CH_4, NH_3, H_2O, NH_4^+, PCl_5, SF_6, ClF_3. Orbital overlapping – Hybridization sp, sp^2, sp^3, sp^3d, sp^3d^2, d^2sp^3 and dsp^2 hybridization. V B Theory. MO theory. Formation of B_2, C_2, N_2 and O_2 molecules. Hydrogen bonding, types of hydrogen bonding – examples.

Module III : Radio activity and Nuclear Chemistry (10 hrs)

Concept of nuclides – representation of nuclides – isobars, isotopes and isotones with examples – Detection of isotopes using Aston's mass spectrograph – separation of isotopes by diffusion methods – stability of nucleus – n/p ratio. Liquid drop model, Radioactivity – natural and artificial. Decay constant and half-life period-Radioactive series – Group displacement law – radio isotopes and their applications in structural elucidation, in agriculture and in industry – Radiocarbon dating – Nuclear fission and nuclear fusion. Problems associated in the nuclear waste disposal. Derivation of decay constant – Atomic bomb and hydrogen bomb. Mass defect, Nuclear binding energy.

Module IV : Electrochemistry (6 hrs)

Electrolysis – metallic and ionic conductors. Migration of ions – relative speed of ions – Transport number – determination of transport number using Hittorf's method. Kohlrausch's law and applications. Conductometric titrations – advantages. Ohms law – specific conductance – molar conductance and equivalent conductance – variation with dilution.

2C02CHE CHEMISTRY

For Physical & Biological Sciences

Contact Hrs – 36

Credit - 2

Module I : Chemical kinetics and catalysis (10 hrs)

Definition – reaction rate – factors affecting the rate of a chemical reaction – units – Zero order reactions – Order versus molecularity. Pseudo order reactions – Integrated rate equation for first order reaction – half life – determination of the order – Half life method and Graphical method – Ester hydrolysis – equation. Collission theory (qualitative) Effect of temperature on reaction rate – calculation of Ea from the values of k at two temperatures. Transition state theory (qualitative). Types of catalysis – homogeneous and heterogeneous. Characteristics of catalysis reactions – promoters and catalytic poisons. Activation energy and catalysis.

Module II : Chemical equilibrium (6 hours)

Reversible reactions – Nature of chemical equilibrium – Characteristics of chemical equilibrium – Equilibrium constant – in terms of partial pressure – thermo dynamic derivation of chemical equilibrium. Liquid systems – Le-Chatlier's Principle – Effects of temperature, pressure and concentrations.

Module III : Photochemistry (4 hrs)

Chemical reactions Vs Photochemical Reactions. Laws of photo chemistry – Grothus – Draper Law and Stark-Einstein law of photo chemistry. Quantum yield – Hydrogen Chlorine reactions. Photo sensitized reactions – Fluorescence and Phosphorescence – Chemiluminescence and bioluminescence.

Module IV : Colloids (8 hrs)

Classification – preparation – structure and stability – The electrical double layer – zeta potential – Properties of Colloids – Tyndall effect – Brownian movement-Coagulation of colloidal solution – Hardy-Schultz rule – Flocculation value – protective

colloids – Gold number – Emulsions – oil in water and water in oil type emulsions – Emulsifying agents – Gels – imbibition – syneresis – applications of colloids in food, medicine and industry.

Module V : Analytical Chemistry (8 hrs)

Analytical chemistry – classification – accuracy and precision. Errors, Solubility product – ionic product – common ion effect principle of separation of cations in various groups. pH pOH and ionic product of water. Buffer solutions – Hendersons equations. Principle of volumetric analysis – Adidimetry and alkalimetry, permanganometry, dichrometry, iodometry and iodimetry. Chromatography – column – TLC and paper. Principles and applications.

3C03CHE CHEMISTRY

For Biological Sciences

Contact Hrs –54

Credit – 2

Module I : Metallurgy (6 hrs)

Metallurgy of aluminium, nickel, titanium and thorium

Module II : Co-ordination Chemistry (10 hrs)

Co-ordination compounds and complex ions –co-ordination number – ligand denticity. Chelating ligands and chelates – Werners theory – Nomenclature of co-ordination compounds – Affective Atomic Number – Factors affecting the stability of complex ions – valence bond theory of complexes – application of complexes.

Mo**dule III : Introduction to organic chemistry (7 hrs)**

Classification of organic compounds – functional groups, homologous series – Shapes of molecules like methane, ethane, ethylene and acetylene – nomenclature of hydrocarbons. Nomenclature of organic compounds bearing functional groups – Benzene structure – Aromaticity, Huckel's rule.

Module IV : Organic reaction mechanisms (11 hrs)

Electron displacement effects - inductive effects – Electrometric effect. Resonance – Hyper conjugative effect and steric effect. Bond fission – Homolysis and heterolysis carbonium ion-carbanion and free radicals – their stability. Classifications of organic reactions – Mechanisms of SN^1 and SN^2 reaction. Walden inversion. Elimination reactions - E^1 and E^2 reactions. Addition of hydrohalogen acids – Markownikoff's rule – peroxide effect. Aromatic electrophilic substitution reactions. Mechanisms of chlorination, nitration, sulphonation and Friedel Crafts reaction – Orientation effect and o, p ratio.

Module V : Stereochemistry (10 hrs)

Isomerism – general – stereoisomerism – optical isomerism – chirality – plane polarized light – specific rotation – enentiomerism – recemization – diastereo isomer – optical activity of lactic acid and tartaric acid – meso tartaric acid – resolution – conformational isomerism – ethane, propane and cyclohexane – chair and boat forms-stability – geometrical isomerism – causes – maleic acid and fumaric acid – 1-butene and 2-butene stability.

Module VI : Organic spectroscopy (10 hrs)

Basic principles – UV visible spectroscopy – formation of absorption bands – Types of electronic transition. Auxochromes, Bathochromes, Hyperchromic and Hypo chromic shift – applications. IR, NMR and Mass spectrometry – Important applications in Organic chemistry (No derivations).

4C04CHE CHEMISTRY

For Biological Sciences

Contact Hrs –54

Credit – 2

Module I : Carbohydrates (8 hrs)

Introduction – Definition and classification. Synthesis and properties of Glucose, Fructose and Sucrose – Mutarotation – Epimers and Anomers. D and L configuration. Conversion of glucose into fructose and fructose into glucose. Cane sugar – Structure and important properties – Polysaccharides. Starch, Cellulose and Chitin – structure, properties and tests.

Module II : Heterocyclic compounds (10 hrs)

Hetrocyclic systems – 5 membered, 6 membered and condensed systems. Structure of pyrrole, Furan and Thiophene. Electrophilic substitution in pyrrole, Furan and Thiophene. Reactivity and orientation – Saturated 5 numbered heterocyclics – Structure and properties of pyridine. Electorphillic and nucleophillic substitution reactions in pyridine – Basicity and reduction. Quinoline and isoquinoline – preparation and properties.

Module III : Nucleic acids (7 hrs)

Classification – structure of DNA and RNA – Functions of Nucleic Acids – DNA replication – Bio synthesis of Proteins – Test for DNA and RNA.

Module IV : Amino acids and proteins (10 hrs)

Classification of Amino acids – Physical and Chemical Properties – Zwitter ions – Iso Electric point – Sorensons formal titration – chromatographic separation of amino

acids – Peptides – Proteins classification, characterization by electrolysis – Primary, Secondary and Tertiary level structures of proteins – Tests for Proteins.

Module VI : Enzymes, Vitamins and Hormones (10 hrs)

Enzymes – General Nature – Mechanism of Enzyme action, Enzyme catalysis, Michael – Mention equation (No derivation) – Application of Enzymes, Enzyme deficiency deceases – Vitamins – Classifications structure of Vitamin A, B and C. Hormones – Classification – Structures of progesterone, Testosterone, cortisone, adrenaline and Thyroxine.

Module VII : Bio inorganic compounds (9 hrs)

Introduction – Metal ions in biological system – Metals in medicine – metal – nucleic acid interaction – biochemistry of iron – haemoglobin and myoglobin – structure and functions – mechanism of oxygen binding – Na-K pump – bio chemistry of Zn and Co- Ca in biological system.

3C03CHE CHEMISTRY

For Physical Science

Contact Hrs –54

Credit – 2

Module I : Spectroscopy (8 Hrs)

Introduction - Types of spectra – Rotational, vibrational and electronic spectra. Moment of intertia and bond length – Vibrational – Rotational or IR spectra – Force constants. Raman's spectra – Stokes and Anti Stokes LInes – NMR spectra.

Module II : Thermodynamics (5 Hrs)

BASIC CONCEPTS – System – surroundings – open, closed and isolated systems – Isothermal – isochloric and isobaric process – work – heat – energy – internal energy – Heat capacity at constant volume (Cv) and at constant pressure (Cp) – relation between Cp and Cv – First law First law – The second law – concepts spontaneous and non spontaneous processes – statement of second law – entropy – entropy changes accompanying phase transitions – variation of entropy with temperature.

Module II : Metallurgy (6):

Metallurgy of aluminium, nickel, titanium and thorium.

Module III : Co-ordination compounds (10 Hrs)

Co-ordination compounds and complex ions – co-ordination number – ligand denticity. Chelating ligands and chelates – Werners theory – Nomenclature of co-

ordination compounds – Affective Atomic Number – Factors affecting the stability of complex ions – valence bond theory of complexes – application of complexes.

Module IV : Introduction to organic chemistry (7 Hrs)

Classification of organic compounds – functional groups, Homologous series – shapes of molecules like methane, ethane, ethylene and acetylene – nomenclature of hydrocarbons. Nomenclature of organic compounds bearing functional groups – Benzene structure – Aromaticity Huckel's rule.

Reaction mechanism – electron displacement effect – inductive effects – electromeric effect – resonance – hyper conjugative effect – and sterric effect – bond fission – homolysis and heterolysis – carbonium ion – carbanion – and free radicals – their stability.

Module V: Sterochemistry (10 Hrs)

Isomerism – general – stereoisomerism – optical isomerism – chirality – plane polarized light – specific rotation – enentiomerism – recemization – diastereo isomer – optical activity of lactic acid and tartaric acid – meso tartaric acid – resolution – conformational isomerism – ethane, propane and cyclohexane – chair and boat forms – stability – geometrical isomerism – causes – maleic acid and fumaric acid – 1. Butene and 2 butene – stability.

Module VI : Organometallic compounds (8 Hrs)

Organometallic compounds – ionic compounds – compounds of elements of group 2 to 5 – compounds of transition elements – multicentric bonds with pi-bonded ligands – bonding in pi-metal complexes. Bonding in ferrocene – Reactions of C_5H_5 Rings – Grignard Reagent – Tetra ethyl lead.

4C04CHE CHEMISTRY

For physical science

Contact Hrs –54

Credit - 2

Module : Gaseous state (6 Hrs)

Ideal gas equation – deviation of gas laws from ideal behaviour – reasons for deviation – Van der Waals equation – critical constants and experimental determination – liquefaction of gases – Linde and Claude's processes – Velocities of gas molecules – average, most probable and RMS velocities – problems.

Module II : Crystallinestate (9 Hrs)

Solids – crystalline and amorphous solids – space lattice and unit cell- crystal planes laws of crystallography – Weiss's indices and Miller indices - Bravais lattice – different Bravais lattices of cubic crystals – characteristic planes in these lattices – interplanar distance ratio – X-ray analysis of crystals – Bragg's equation – problem – crystal structure of NaCl – Liquid crystals – types, properties and applications.

Module III : Electromotive force (8 Hrs)

Electro chemical cell – Daniel cell – Cell reaction – Single electrode potential – statement – explanation of Nernst equation – Standard hydrogen electrode – Calomel electrode – measurement of EMF – determination of pH using Hydrogen electrode – Potentiometric titration – concentration cells.

Module IV : Ionic equilibria (7 Hrs)

Oswald's dilution law – Debye – Huckel theory of strong electrolytes – Relaxation effect and Electrophoretic effect. Degree of dissociation. Common ion effect – Factors influencing degree of dissociation. Solubility product. Salt hydrolysis. Quantitative aspects of salt hydrolysis – determination of degree of hydrolysis. Salts of strong acid and weak bases. Salts of weak acids and weak bases.

Module V : Binary Liquid Systems (7 Hrs)

Solutions – Types – Thermodynamic properties of a solution – condition for equilibrium between phases – ideal solutions – Raoult's Law – Vapour pressure of ideal solutions and real solutions – Boiling point diagrams of miscible binary mixtures. Distillation of binary miscible solutions – Azeotropes – Vapour pressure and distillation of immiscible liquids.

Module VI : Phase rule (6 Hrs)

Statement and expression of phase rule – Phase diagrams – Study of Water and Sulphur systems – Two component systems involving simple eutectic – Lead – silver system – Desilverisation of lead – Pattinson's process – Deliquescence efflorescence.

Module VII : Instrumental methods in Chemistry (11 Hrs)

Thermal methods of analysis – TGA mand DTA – instrumentation – application – characterisation of polymers. Spectrophotometry-basic instrumentation of UV – visible spectrophotometry – maximum optical density measurement – IR basic details – application. Electro analytical method – amperometry – amperometric titration – applications – advantages and disadvantages.

Reference Books

1. Inorganic chemistry : Puri and Sharma
2. Inorganic chemistry : P.L.Soni

3.	Concise inorganic chemistry	:	J.D.Lee
4.	Basic inorganic chemistry	:	Cotton and Wilkinson
5.	Physical Chemistry	:	Puri and Sharma
6.	Organic Chemistry	:	Thivari, Malhotra and Vishnoi
7.	Organic reaction mechanism	:	Peter Sykes
8.	Organic reaction mechanism	:	Mukherjee and Singh
9.	Pragathi's Instrumental Methods of Analysis	:	H.Kaur

4C05CHE COMPLEMENTARY CHEMISTRY PRACTICAL

1. **Qualitative Inorganic Mixture Analysis**

   a. **Reactions of cations:**

   Study of the reactions of the following cations with a view of their identification and confirmation.

   Lead, Copper, Bismuth, Cadmium, Arsenic, Antimony, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Barium, Calcium, Magnesium and Ammonium.

   b. Systematic qualitative analysis of a solution containing any two of the cations given in (a) by semi micro methods.

2. **Volumetric Analysis**

   a. Introduction to electronic balance and analytical balance – volumetric apparatus – filtration, Equivalent and molecular mass of compounds – Normality and Molarity – Primary standards – Preparation of standard solution – Principles of Volumetric analysis.

   b. For acidimetry, alkalimetry and permanganometry two burette method may be used and for other volumetric analyses conventional methods can be used.

(Students should prepare standard solutions. The experiments should have the making up of the given solution and double titration in each experiment)

a. Acidimetry and alkalimetry

Estimation of (a) strong acids (b) strong bases (c) weak acids (d) weak bases.

b. Permanganometry

Estimation of (a) Fe^{2+}/$FeSo_4.7H_2O$/Mohr's salt (b) Oxalic acid

c. Dichrometry

Estimation of (a) Fe^{2+} using internal indicator (b) Fe^{3+} after reduction with stannous chloride/HC1

d. Iodimetry and iodometry

Estimations of (a) copper (b) potassium dichromate and (c) Potassium permanganate.

3. **Gravimetric Analysis**
   a. Determination of percentage of water of crystallization in crystalline Barium Chloride.
   b. Estimation of barium as barium sulphate.
4. **Determination of physical constants**

   Determination of melting and boiling points of organic compounds.
5. **Preparation of organic compounds**
   (a) Acetanilide from Aniline.
   (b) Benzoic acid from Benzaldehyde.
   (c) Meta dinitrobenzene from Nitrobenzene.

VIVA VOCE

References

1. A.I.Vogel - "A Text Book of Qualitative Analysis including semi micro methods".
2. V.V.Ramanujan – "Semi micro Qualitative Analysis".
3. A.O.Vogel – "A Text Book of Quantitative inorganic Analysis".

COMPLEMENTARY CHEMISTRY PRACTICAL

(Done at the end of the 4th Semester)

Time : 4 Hours

Credit: 4

1. Identify and confirm the two cations in the given solution by systematic qualitative analysis. Submit a record of your tests, observation and inferences along with the report.
2. Determine …….

3. In the first ten minutes,
   a. Write a brief outline of the procedure you would adopt for the estimation of …….. in the given solution, given …… and,
   b. Calculate the mass of ……
4. Viva Voce

Mark distribution

Sd/-
Dr.K.Pradeep Kumar,
Chairman,Board of Studies in Chemistry (UG)