GUJARAT UNIVERSITY
B. Sc. SEMESTER II
CHEMISTRY
EFFECTIVE FROM – JUNE 2023
ACCORDING TO NEP – 2020

Course Structure with respect to credit, hours and marks

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Mark
					Internal	External	
Discipline specific Courses – Core	DSC-C-CHE 121T General Chemistry	4	4	2	50	50	100
	DSC-C-CHE 122P	4	8	6	50	50	100

*** Practical Exam (3 Hour + 3 Hour = 6 Hour)**
*** DSC-C- CHE 122P = CHEMISTRY PRACTICAL**
N.B.: Each practical batch should have 10 students
No. of students per batch during practical exam = 10

DSC-C- CHE 121T
GENERAL CHEMISTRY

Learning Objectives:

- To understand the development of chemistry as Indian knowledge and as philosophy in the ancient India.
- To develop the basic knowledge and conceptual ideas regarding the structure of atoms.
- To study the different models of structure of atoms.
- To know the basic knowledge of quantum mechanics.
- To understand shapes of the different atomic orbitals.
- To understand conceptual knowledge of different electrolytes and their electrical conductance.
- To study the relation between dilution and conductance.
- To study the hydrolysis of different salts and their different equations.
- To explain the relationship between useful pH range and indicator.
- To understand the basic concepts of Radioactivity and its principle.
- To study the stability of nucleus and factors affecting on the stability of nucleus.
- To understand the radioactive reactions and radioactive energy.

Learning outcomes:

By the end of the course, the students will be able to:

- Learn the history of Indian Chemistry, ancient Indian knowledge and philosophy of chemistry.
- Learn significance of the Indian knowledge with modern scientific perspectives.
- Learn scientific theory of atoms, concept of wave functions and the fundamentals of quantum mechanics.
- Solve the conceptual questions regarding quantum numbers, electronic configuration, shapes of the orbitals, radial and angular distribution curves.
- Learn the different types of electrolytes and conductance, dissociation of electrolytes and their applications.
- Solve the conceptual questions regarding hydrolysis of salts, pH of the solutions and buffer solutions.
- Learn the application of nuclear energy and nuclear reactions.
- Know half-life, Average life.
- Learn Nuclear reactions, Nuclear Fission and fusion reactions, Artificial radioactivity.

B. Sc. SEMESTER II
DSC – C – CHE 121T
GENERAL CHEMISTRY

UNIT I: History of Chemistry in Ancient India: Indic Knowledge System [25 Marks] [15 Hours]

Pre-Harappan Period, Post-Harappan Period, Chemistry in Indus Vally Civilisation, Chemistry in Vedic Period, The Constitution and properties of Matter: Atomic theory, Combination of Atom, Atomic theory Of Jainas.

UNIT II: Nuclear Chemistry [25 Marks] [15 Hours]

Radioactivity, Types of radiations, Detection and Measurement of radioactivity, Types of radioactive decay, Fajans-Soddy group displacement law, Radioactive disintegration series, Rate of radioactive decay, Units of radioactivity, Half-life, Calculation of half-life and sample left after time T, Average life, nuclear reactions, Nuclear Fission and fusion reactions, Artificial radioactivity, Energy released in nuclear reactions (Einstein's equation relating mass and energy), Mass defect, nuclear binding energy and its calculation, Neutron-Proton ratio and nuclear stability, nuclear reactor, nuclear power plant.

UNIT III: Atomic structure [25 Marks] [15 Hours]

Bohr's principle and its limitations, atomic spectrum of Hydrogen atom, Development leading to Quantum or Wave mechanical model of atom, de Broglie equation, Heisenberg's Uncertainty principle and its significance, Need of Quantum mechanical model of atom, Schrodinger wave equation, significance of ψ and ψ^2, Quantum mechanical model of atom (Concept of atomic orbital), Difference between orbit and orbital, Quantum numbers and their significance, Radial and angular wave function for hydrogen atom, Radial function plots, Radial probability distribution plots, Shape of s, p and d atomic orbitals, Boundary surface diagram, Relative energies of orbitals, Aufbau principle and its limitations, Pauli Exclusion principle, Hund's rule of maximum multiplicity.

UNIT IV: Ionic Equilibrium [25 Marks] [15 Hours]

Definition of basic terms: Electrical conductance, Specific conductance, Equivalent conductance, Molar conductance, Cell constant and its determination, Incomplete dissociation, Degree of dissociation, Oswald's dilution law and its limitations, Kohlrausch law and its application, Debye – Huckel theory, Self-ionization of water and Ionic product of water Kw, pH Scale, Hydrolysis of different salts (strong acid and weak base, strong base and weak acid, weak acid and weak base) including relation between Ka , Kb , Kh , h, Kw and

their pH equation, Buffer Solutions, Henderson – Hasselbalch equation, Indicator theory, useful pH range of indicator for acid and base titration.

REFERENCE BOOKS

1. '**Concise Inorganic Chemistry**' by J. D. Lee, 5th Ed., 2013, Wiley India.
2. '**Basic Inorganic Chemistry'** by F. A. Cotton, Geoffrey Wilkinson, Carlos A Murillo and Manfred Bochmann, 6th Ed., Wiley publication.
3. '**Inorganic Chemistry'** by Shriver & Atkins, 5th Ed., 2013, Oxford University Press.
4. **'Satya Prakash's Modern Inorganic Chemistry'** by Dr. R. D. Madan, 1987, S. Chand, New Delhi.
5. **'Principles of Inorganic Chemistry'** by Puri, Sharma and Kalia, 2018, Vishal Publishing Co., Jallandhar – Delhi.
6.'**Introductory Quantum Chemistry'** by A. K. Chandra, 4th Ed., 2017, Tata Mc Graw Hill Publishing Company Limited, New Delhi.
7.'**Quantum chemistry'** by R. K. Prasad, 2nd Ed., 1996, New Age International publishers.
8.'**Elements of Quantum Mechanics**' by Michael D. Fayer, Indian Ed., 2001, Oxford University Press.
9. '**Elements of Physical Chemistry**' by Peter Atkins & Julio De Paula, 5/E, Indian Edition, Oxford University Press.
10. '**Physical Chemistry**' by P. W. Atkins, 7/E, 2002, Indian Edition Oxford University Press.
11. '**Physical Chemistry**' by W. J. Moore, 6/E, 1996, MacGraw Hill Publication.
12. '**Principle of Physical Chemistry'** by Puri, Sharma & Pathania, 41/E, Vishal Publishers.
13. '**Essentials of Physical Chemistry'** by Bahl & Tuli, 22/E, S. Chand publication, New Delhi.
14. '**Advanced Physical Chemistry**' by Gurdeep Raj, 19/E, Goel Publishing House Meerut
15. **'History of Chemistry in Ancient and Medieval India'** by P. Ray, Pages 1-48.

DSC – C – CHE 122P

Learning Objectives:

- To know iodimetry and iodometry titrations.
- To understand calibration and application of pH- meter.
- To study the principles of inorganic qualitative analysis.
- To understand the detection of positive and negative ion present in the salt.
- To study how to perform dry test and wet test for radicals.

Learning outcomes:

By the end of the course, the students will be able to:

- Understand difference between iodimetry and iodometry titrations.
- Operate and calibrate pH – meter.
- Understand the theory and applications of titrations.
- Perform different test for inorganic qualitative analysis.
- Identify positive and negative ion present in the salt.

DSC – C – CHE 122P
CHEMISTRY LAB – CIII LAB

[50 marks]
[60 Hours]

Basic awareness to lab instruments, reagents, indicators & lab. technics.

(I) Volumetric Titrations
Preparation of solutions of different Normality, Molarity, %V/V, %W/V, %W/W.

(II) Acid base titrations
1. Na_2CO_3 → 0.1N HCl
2. Estimation of carbonate and bicarbonate together → 0.1N HCl

(III) Redox titration
Preparation of standard solutions of $KMnO_4$
1. Std. $KMnO_4$ → Oxalic acid

(IV) Complexometric Titration
Preparation of standard solutions of EDTA.
1. Zn^{++} → Std. EDTA

(V) Iodimetry Titration
Preparation of standard solutions of $Na_2S_2O_3.5H_2O$.
1. Iodine → Std. Sodium thiosulphate

(VI) Iodometry Titration
Preparation of standard solutions of $Na_2S_2O_3.5H_2O$.
1. $CuSO_4.5H_2O$ → Std. $Na_2S_2O_3.5H_2O$.
2. $K_2Cr_2O_7$ → Std. $Na_2S_2O_3.5H_2O$.

Demonstration
Concept of pH, buffer solution, electrodes
1. Demonstration of pH – meter and measurement of pH of 0.1N HCl solution.
2. Preparation of an acidic buffer (CH_3COONa - CH_3COOH, pH = 5) and its pH measurement.
3. Preparation of a basic buffer (NH_4Cl - NH_4OH, pH = 10) and its pH measurement.

Viva-Voce questions

CHEMISTRY LAB – C IV LAB

[50 marks]
[60 Hours]

Inorganic Qualitative analysis

Concept of basic principles of Inorganic Qualitative analysis, ionic product (IP), solubility product (Ksp), common ion effect, chemical equations.

Inorganic salts (minimum requirement 20 salts)

K^{+}, NH_4^{+}, Fe^{++}, Fe^{+++}, Al^{+++}, Zn^{++}, Mn^{++}, Ni^{++}, Ca^{++}, Ba^{++}, Sr^{++}, Mg^{++} in the form of Cl^{-}, Br^{-}, I^{-}, NO_3^{-}, SO_4^{-2}, S^{-2}, PO_4^{-3}, CrO_4^{-2}, O^{-2}.

Demonstration

Introduction to chromatography, Principle of paper chromatography, Concept of stationary phase, mobile phase/ developer, solute/ elute, visualizing agent, and Rf value to be discussed.

1. 1st group cations: Ag, Pb, Hg ions
2. 2nd group cations: Cu, Cd ions

Viva-Voce questions

REFERENCE BOOKS

1.'**Vogel's Textbook of Quantitative Chemical analysis'** Revised by G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney, ELBS (English Language Book Society) Longman. 5th Ed., New York.

2.**'Analytical Chemistry'** by Dhruba Charan Dash, 2011, 2th Ed., PHI Learning Private Ltd, New Delhi.

3.'**Analytical Chemistry' by Gary D. Christian,** 1986**,** 4th Ed., John Wiley & Sons.

4. '**Advanced Practical Inorganic Chemistry'** by Gurdeep Raj, 9th Ed., Goel Publishing House, Meerut.

5. **'Advanced University Practical Chemistry'** by P. C. Kamboj, Vishal Publishing Co., Jallandhar – Delhi.