



**SarvodayaKelavaniSamaj managed,
ShreeManibhai Virani and Smt.NavalbenViraniScience College
(Autonomous)**

(Affiliated to SaurashtraUniversity, Rajkot)

Re-Accredited at 'A' Level by NAAC

STAR college Scheme & Status by MST-DBT

UGC-College with Potential for Excellence (CPE)

UGC-DDU KAUSHAL Kendra

GAAA –Grade A-1 by KCG, Government of Gujarat

GPCB-Government of Gujarat approved EnvironmentAuditCenter

Nodal Center for capacity building by GSBTM

**Syllabus for DSE-Allied offered to B.Sc. Industrial Chemistry &
B.Sc. Biotechnology Program**

DSE Allied for Department of Industrial Chemistry

Semester - I		
Course Code	Course Title	Course Credit and hrs
19UICDA101	Chemistry -I	3 Credits - 3 hrs./wk

Course objectives:

To enable the students to

- Understand elementary concepts of Atomic structure and Periodicity of elements.
- Develop the ability to find out various modes of concentration of acid and base.
- Understand the basics of thermodynamics and thermo chemistry.
- Introduction to fundamental knowledge of organic chemistry and stereo chemistry.

Course content:

Unit – 1: Fundamentals of Inorganic Chemistry–I (13 Hrs.)

(1) Atomic Structure:

- Bohr's Theory & its limitation
- Quantum numbers
- Shapes of orbital
- Principles: Auf-Bau, Pauli, Hund, for Electronic configurations

(2) Periodic Properties:

- Various periodic trends in periodic table
- Atomic radius
- Ionic radius – Effective nuclear charge
- Pauling's method for the determination of ionic radius
- Ionization energy
- Electron affinity
- Electronegativity

Unit – 2: Fundamentals of Analytical Chemistry–I (13 Hrs.)

(3) Modes of Concentration:

- Introduction
- Theory of Solution, Solvent, Solute
- Primary & Secondary standard solutions
- Determination of Molecular weight and eq. weight
- Different modes of concentration - Normality, Molarity, Molality, Mole fraction, % W/W, % W/V, % V/V, ppm
- Numericals

(4) Acid- Base & Buffers

- Introduction, Definitions – Acids and Bases
- Strong and weak electrolytes
- Degree of ionization
- Ionic product of water
- Ionization of weak acid and weak base
- pH scale
- Common ion effect
- Buffers & types of Buffers
- Mechanism of Buffers
- Determination of pH of buffer by Henderson equation
- Buffer capacity

Unit – 3: Fundamentals of Physical Chemistry–I

(10 Hrs.)

(5) Thermodynamics

- Introduction
- System, surrounding, types of system
- Thermodynamic processes, Macroscopic properties
- State function & Path function
- Concept of Heat & work
- Zeroth law (Statement & Mathematical expression)
- First law (Statement & Derivation)

(6) Thermo chemistry

- Exothermic and endothermic reactions
- Heat of reaction: Combustion, Solution, Neutralization, Vaporization, Sublimation, Transition
- Bond dissociation energy
- Hess's law

Unit – 4: Fundamentals of Organic Chemistry–I

(12 Hrs.)

(7) Basics of Organic compounds

- **Organic compounds:** Classification, Nomenclature, hybridization,
- **Electronic displacement:** Study of various effects: Inductive effect, Electromeric effect, Resonance & Mesomeric effect and Hyper conjugation and their applications
- **Reaction Intermediates:** Hemolytic and heterolytic bond fission, Curly arrow rules, Nucleophile, Electrophile
- Types, shape, formation, relative stability of reaction intermediates - Carbocation, Carbanion, Carbon free radical
- Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.

Unit – 5: Fundamentals of Stereochemistry

(12 Hrs.)

(8) Basics of Stereochemistry

- Isomerism - (Types)
- **Optical Isomerism:** Chirality/Asymmetry
- Wedge- Dash Formula
- Fischer projection
- Newmann and Sawhorse projection and their Inter conversion
- Enantiomer
- Relative and Absolute configuration
- D/L and R/S designation, CIP rules
- Molecules with Two or more chiral centre
- Meso Compounds & Diastereomer
- **Geometrical Isomerism:** Cis – Trans, Syn – Anti, E-Z with CIP rules
- Optical activity & Specific rotation
- Racemic mixture & Resolution

Text Books:

1. Bansal, Raj K. (2009, Fifth) *A Textbook of Organic Chemistry*. New Delhi: New Age International (ISBN: 978-81-224-2025-8).(Unit-1&4)
2. Bahl, Arun; Bahl, B. S.; Tuli, G. D. (2010) *Essential of Physical Chemistry*. New Delhi : S. Chand (ISBN No. 81-219-2978-4) .(Unit-5)

Reference Books:

1. Ahluwalia, V. K. (2011, 4th edition) *Organic Reaction Mechanism*. New Delhi: Narosa (ISBN: 978-81-8487-115-9).
2. T.W. Graham Solomons (2011, 10th edition) *Organic Chemistry*. Hoboken: John Willey & Sons (ISBN: 978-0-470-55659-7).
3. Negi, A. S.; Anand, S. C. (2007, 2nd edition) *A Textbook of Physical Chemistry*. New Delhi: New age International Publisher (ISBN: 81-224-2005-0).
4. Peter Atkins (2006) *Atkin's Physical Chemistry*. Oxford: OxfordUniversity Press (ISBN: 9780198700722).

Semester - I		
Course Code	Course Title	Course Credit and hrs
19UICDA101	Chemistry Practical -I	1 Credits – 2 hrs./wk

Course objectives:

To enable the students to

- Identify unknown Inorganic compounds
- Develop skill to prepare and standardize solution for acid base titration

Laboratory experiments:

- Volumetric Analysis Acid-Base (04)
- Inorganic Qualitative Analysis (Minimum: 08)

Semester - II		
Course Code	Course Title	Course Credit and hrs
19UICDA201	Chemistry -II	3 Credits - 3 hrs./wk

Course objectives:

To enable the students to

- Understand elementary concepts of bonding.
- Develop the understanding of rate and orders of chemical reactions with determinations.
- Understand basic heterocyclic compounds and their properties.
- To understand the aspect of electrochemistry and their applications.

Course Content

Unit – 1: Fundamental Inorganic Chemistry–II (12 Hrs.)

(1) Chemical Bonding

- Types of Bonds:
 - Covalent
 - Covalent Coordinate
 - Ionic
 - Metallic
 - Van der Waals Forces
 - Hydrogen bond
- Hybridization:
 - sp – $BeCl_2$
 - sp^2 – BF_3
 - sp^3 – CH_4
 - sp^3d – PCl_5
 - sp^3d^2 – SF_6
- Sidgwick Powell rule- VSEPR theory
- Valence bond theory and its limitations

Unit – 2: Fundamental Physical Chemistry–II (12 Hrs.)

(2) Chemical Kinetics

- Introduction
- Reaction rate, Order and Molecularity of reaction
- Derivation, Characteristics, Half life time & Examples of
 - Zero order reaction
 - First order reaction
- Method for determining the order of reaction: (I) Graphical method (II) Ostwald's isolation method (III) Method of half-life period (V) Integration method
- Energy of Activation and catalysis

Unit – 3: Fundamental Organic Chemistry–II (12 Hrs.)

(3) Aromatic Hydrocarbons

- Structure of benzene & toluene
- Various electrophilic aromatic substitution with mechanism:
 - Nitration,

- Sulphonation,
- F.C.R- Alkyl & Acylation,
- Halogenations
- Directing effects of the groups
- Aromaticity
- Huckel rule, Benzenoid and non benzenoid structures.

Unit – 4: Electro Chemistry

(12 Hrs.)

(4) Basics of Electro Chemistry

- Introduction
- Reversible and Irreversible cell
- Type of electrodes
- Measurement of EMF of cells
- Thermodynamics of electrode and cell potentials – Nernst equation,
- Standard electrode potential & measurement,

Unit – 5: Heterocyclic Chemistry

(12 Hrs.)

(5) Basics of Heterocyclic Chemistry

- Nomenclature, Preparation and Properties of:
 - Pyrrole
 - Furan
 - Thiophene
 - Pyridine
 - Quinoline
 - Isoquinoline

Text Books:

1. Puri, B. R.; Sharma, L. R. & Kalia, K. C. (2010-11) *Principles of Inorganic Chemistry*. New Delhi : Milestone (Unit-1&5)
2. Bahl, Arun; Bahl, B. S.; Tuli, G. D. (2010) *Essential of Physical Chemistry*. New Delhi : S. Chand (ISBN No. 81-219-2978-4)(Unit-1&4)
3. Heterocyclic Chemistry by Raj K. Bansal (Unit-3)

Reference Books:

1. Madan, R. L. (2011) *Chemistry for degree student First year*. New Delhi: S. Chand (ISBN: 81-219-3230-0).
2. Lee, J. D. (2002, 5th edition) *Concise Inorganic Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 0-632-05293-7).
3. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller & Fraser Armstrong (2010, 5th edition) *Inorganic Chemistry*. Oxford: Oxford University Press (ISBN: 978-0-19-959960-8).
4. Introductory Heterocyclic Chemistry by Peter A. Jacobi
5. Heterocyclic Chemistry by A.R.Parikh, H.H.Parekh and R.C.Khunt
6. Douglas A. Skoog, West, Holler, Crouch (2004, 8th edition) *Fundamental of Analytical Chemistry*. Mexico: Thomson-Brooks/Cole (ISBN: 81-315-0051-9).
7. Sharma, B. K. (2014) *Instrumental Method of Chemical Analysis*. Meerut: GOEL publishing House (ISBN: 978-81-8283-099-8).
8. Christian, Gary D.; Dasgupta, Purnendu K.; Schug, Kevin A. (2007, 6th edition) *Analytical Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 978-81-265-1113-6).

Semester - II		
Course Code	Course Title	Course Credit and hrs
19UICDA202	Chemistry Practical -II	1 Credits – 2 hrs./wk

Course objectives:

To enable the students to

- Identify unknown organic compounds
- Develop skill to prepare and standardize solution for complexometric titration
- Develop skill to determine concentration of metal ion in the given solution by complexometric method.

Laboratory experiments:

- Titrimetric analysis: Complexometric (04)
- Organic Qualitative Analysis (Minimum: 08)

DSE Allied for Department of Biotechnology

Semester - I		
Course Code	Course Title	Course Credit and hrs
19UBTDA101	Chemistry -I	4 Credits - 4 hrs./wk

Course objectives:

To enable the students to

- Understand elementary concepts of Atomic structure and Periodicity of elements.
- Develop the ability to find out various modes of concentration of acid and base.
- Understand the basics of thermodynamics and thermo chemistry.
- Introduction to fundamental knowledge of organic chemistry and stereo chemistry.

Course content:

Unit – 1: Fundamentals of Inorganic Chemistry–I (13 Hrs.)

(1) Atomic Structure:

- Bohr's Theory & its limitation
- Quantum numbers
- Shapes of orbital
- Principles: Auf-Bau, Pauli, Hund, for Electronic configurations

(2) Periodic Properties:

- Various periodic trends in periodic table
- Atomic radius
- Ionic radius – Effective nuclear charge
- Pauling's method for the determination of ionic radius
- Ionization energy
- Electron affinity
- Electronegativity

Unit – 2: Fundamentals of Analytical Chemistry–I (13 Hrs.)

(3) Modes of Concentration:

- Introduction
- Theory of Solution, Solvent, Solute
- Primary & Secondary standard solutions
- Determination of Molecular weight and eq. weight
- Different modes of concentration - Normality, Molarity, Molality, Mole fraction, % W/W, % W/V, % V/V, ppm
- Numericals

(4) Acid- Base & Buffers

- Introduction, Definitions – Acids and Bases
- Strong and weak electrolytes
- Degree of ionization
- Ionic product of water
- Ionization of weak acid and weak base
- pH scale
- Common ion effect
- Buffers & types of Buffers
- Mechanism of Buffers
- Determination of pH of buffer by Henderson equation
- Buffer capacity

Unit – 3: Fundamentals of Physical Chemistry–I

(10 Hrs.)

(5) Thermodynamics

- Introduction
- System, surrounding, types of system
- Thermodynamic processes, Macroscopic properties
- State function & Path function
- Concept of Heat & work
- Zeroth law (Statement & Mathematical expression)
- First law (Statement & Derivation)

(6) Thermo chemistry

- Exothermic and endothermic reactions
- Heat of reaction: Combustion, Solution, Neutralization, Vaporization, Sublimation, Transition
- Bond dissociation energy
- Hess's law

Unit – 4: Fundamentals of Organic Chemistry–I

(12 Hrs.)

(7) Basics of Organic compounds

- **Organic compounds:** Classification, Nomenclature, hybridization,
- **Electronic displacement:** Study of various effects: Inductive effect, Electromeric effect, Resonance & Mesomeric effect and Hyper conjugation and their applications
- **Reaction Intermediates:** Hemolytic and heterolytic bond fission, Curly arrow rules, Nucleophile, Electrophile
- Types, shape, formation, relative stability of reaction intermediates - Carbocation, Carbanion, Carbon free radical
- Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.

Unit – 5: Fundamentals of Stereochemistry

(12 Hrs.)

(8) Basics of Stereochemistry

- Isomerism - (Types)
- **Optical Isomerism:** Chirality/Asymmetry
- Wedge- Dash Formula
- Fischer projection
- Newmann and Sawhorse projection and their Inter conversion
- Enantiomer
- Relative and Absolute configuration
- D/L and R/S designation, CIP rules
- Molecules with Two or more chiral centre
- Meso Compounds & Diastereomer
- **Geometrical Isomerism:** Cis – Trans, Syn – Anti, E-Z with CIP rules
- Optical activity & Specific rotation
- Racemic mixture & Resolution

Text Books:

1. Bansal, Raj K. (2009, Fifth) *A Textbook of Organic Chemistry*. New Delhi: New Age International (ISBN: 978-81-224-2025-8).(Unit-1&4)
2. Bahl, Arun; Bahl, B. S.; Tuli, G. D. (2010) *Essential of Physical Chemistry*. New Delhi : S. Chand (ISBN No. 81-219-2978-4) .(Unit-5)

Reference Books:

1. Ahluwalia, V. K. (2011, 4th edition) *Organic Reaction Mechanism*. New Delhi: Narosa (ISBN: 978-81-8487-115-9).
2. T.W. Graham Solomons (2011, 10th edition) *Organic Chemistry*. Hoboken: John Willey & Sons (ISBN: 978-0-470-55659-7).
3. Negi, A. S.; Anand, S. C. (2007, 2nd edition) *A Textbook of Physical Chemistry*. New Delhi: New age International Publisher (ISBN: 81-224-2005-0).
4. Peter Atkins (2006) *Atkin's Physical Chemistry*. Oxford: OxfordUniversity Press (ISBN: 9780198700722).

Semester - I		
Course Code	Course Title	Course Credit and hrs
19UBTDA102	Chemistry Practical -I	1 Credits - 3 hrs./wk

Course objectives:

To enable the students to

- Identify unknown Inorganic compounds
- Develop skill to prepare and standardize solution for acid base titration

Laboratory experiments:

- Volumetric Analysis Acid-Base (04)
- Inorganic Qualitative Analysis (Minimum: 08)

Semester - II		
Course Code	Course Title	Course Credit and hrs
19UBTDA201	Chemistry -II	4 Credits - 4 hrs./wk

Course objectives:

To enable the students to

- Understand elementary concepts of bonding.
- Develop the understanding of rate and orders of chemical reactions with determinations.
- Understand basic heterocyclic compounds and their properties.
- To understand the aspect of electrochemistry and their applications.

Course Content

Unit – 1: Fundamental Inorganic Chemistry–II (12 Hrs.)

(1) Chemical Bonding

- Types of Bonds:
 - Covalent
 - Covalent Coordinate
 - Ionic
 - Metallic
 - Van der Waals Forces
 - Hydrogen bond
- Hybridization:
 - sp – BeCl_2
 - sp^2 – BF_3
 - sp^3 – CH_4
 - sp^3d – PCl_5
 - sp^3d^2 – SF_6
- Sidgwick Powell rule- VSEPR theory
- Valence bond theory and its limitations

Unit – 2: Fundamental Physical Chemistry–II (12 Hrs.)

(2) Chemical Kinetics

- Introduction
- Reaction rate, Order and Molecularity of reaction
- Derivation, Characteristics, Half life time & Examples of
 - Zero order reaction
 - First order reaction
- Method for determining the order of reaction: (I) Graphical method (II) Ostwald's isolation method (III) Method of half-life period (V) Integration method
- Energy of Activation and catalysis

Unit – 3: Fundamental Organic Chemistry–II (12 Hrs.)

(3) Aromatic Hydrocarbons

- Structure of benzene & toluene
- Various electrophilic aromatic substitution with mechanism:
 - Nitration,

- Sulphonation,
- F.C.R- Alkyl & Acylation,
- Halogenations
- Directing effects of the groups
- Aromaticity
- Huckel rule, Benzenoid and non benzenoid structures.

Unit – 4: Electro Chemistry

(12 Hrs.)

(4) Basics of Electro Chemistry

- Introduction
- Reversible and Irreversible cell
- Type of electrodes
- Measurement of EMF of cells
- Thermodynamics of electrode and cell potentials – Nernst equation,
- Standard electrode potential & measurement,

Unit – 5: Heterocyclic Chemistry

(12 Hrs.)

(5) Basics of Heterocyclic Chemistry

- Nomenclature, Preparation and Properties of:

- Pyrrole
- Furan
- Thiophene
- Pyridine
- Quinoline
- Isoquinoline

Text Books:

1. Puri, B. R.; Sharma, L. R. & Kalia, K. C. (2010-11) *Principles of Inorganic Chemistry*. New Delhi : Milestone (Unit-1&5)
2. Bahl, Arun; Bahl, B. S.; Tuli, G. D. (2010) *Essential of Physical Chemistry*. New Delhi : S. Chand (ISBN No. 81-219-2978-4)(Unit-1&4)
3. Heterocyclic Chemistry by Raj K. Bansal (Unit-3)

Reference Books:

1. Madan, R. L. (2011) *Chemistry for degree student First year*. New Delhi: S. Chand (ISBN: 81-219-3230-0).
2. Lee, J. D. (2002, 5th edition) *Concise Inorganic Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 0-632-05293-7).
3. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller & Fraser Armstrong (2010, 5th edition) *Inorganic Chemistry*. Oxford: Oxford University Press (ISBN: 978-0-19-959960-8).
4. Introductory Heterocyclic Chemistry by Peter A. Jacobi
5. Heterocyclic Chemistry by A.R.Parikh, H.H.Parekh and R.C.Khunt
6. Douglas A. Skoog, West, Holler, Crouch (2004, 8th edition) *Fundamental of Analytical Chemistry*. Mexico: Thomson-Brooks/Cole (ISBN: 81-315-0051-9).
7. Sharma, B. K. (2014) *Instrumental Method of Chemical Analysis*. Meerut: GOEL publishing House (ISBN: 978-81-8283-099-8).
8. Christian, Gary D.; Dasgupta, Purnendu K.; Schug, Kevin A. (2007, 6th edition) *Analytical Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 978-81-265-1113-6).

Semester - II		
Course Code	Course Title	Course Credit and hrs
19UBTDA202	Chemistry -II	1 Credits - 3 hrs./wk

Course objectives:

To enable the students to

- Identify unknown organic compounds
- Develop skill to prepare and standardize solution for complexometric titration
- Develop skill to determine concentration of metal ion in the given solution by complexometric method.

Laboratory experiments:

- Titrimetric analysis: Complexometric (04)
- Organic Qualitative Analysis (Minimum: 08)