Vivekanand Education Society's

College of Arts, Science and Commerce

(Autonomous)

Sindhi Society, Chembur, Mumbai, Maharashtra – 400 071.

Accredited by NAAC "A Grade" in 3rd Cycle - 2017
Best College Award – Urban Area, University of Mumbai (2012-13)
Recipient of FIST Grant (DST) and STAR College Grant (DBT)

Affiliated to the

University of Mumbai

Syllabus for

Program: B.Sc. (Chemistry)

(Program code: VESUSCH)

As per Choice Based Semester and Grading System (CBSGS)
with effect from Academic Year 2022 - 2023

Program Outcomes (PO):

A leaner completing B.Sc. will be able to:

PO1 Demonstrate analytical skills in applying appropriate science principles and methodologies to solve a wide range of problems.

PO2 Design, carry out experiments and analyze results by accounting uncertainties in different quantities measured using various scientific instruments.

PO3 Demonstrate professional behavior of being unbiased, and truthful in all aspects of work as an individual as well as team.

PO4 Broad and balance knowledge in chemistry in addition to understanding of key chemical concepts, principles and theories.

PO5 To develop students' ability and skill to acquire expertise over solving both theoretical and applied chemistry problems

PO6 To impart knowledge on different topics of Chemistry viz., inorganic, organic, physical and analytical; of the level expected from a Graduate in Chemistry

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Program Specific Outcomes (PSO's)

On completion of B.Sc. Chemistry program, learners will be enriched with knowledge and be able to

PSO1 The purpose of the undergraduate chemistry program at the Vivekanand Education Society's College of Arts, Science and Commerce (Autonomous) is to provide the basic concepts in chemistry and various laboratory resources to prepare students for careers and as professionals in the field of chemistry, for graduate study in chemistry, biological chemistry and related Industrial, Pharmaceutical fields.

PSO2 Students will be able to explore new areas of research in both chemistry and allied fields of science and technology

PSO3 To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.

F.Y.B.Sc. (CHEMISTRY)

(SEMESTER I)

Course Code	Title	Credits & Lectures per Semester	Lectures per Week
VESUSCH101	**Chemistry Paper 01**	**02**	**03**
	Unit I : Chemical Thermodynamics and Chemical calculations	**15 Lectures**	
	Unit II: Atomic structure, Periodic Table and periodicity	**15 Lectures**	
	Unit III: Basics of Organic Chemistry: Classification and Nomenclature of Organic Compounds. Bonding and Structure of organic compounds. Fundamentals of organic reaction mechanism	**15 Lectures**	
VESUSCH102	**Chemistry Paper 02**	**02**	**03**
	Unit I: Chemical Kinetics and Liquid state	**15 Lectures**	
	Unit II : Comparative chemistry of Main Group Elements	**15 Lectures**	
	Unit III : Stereochemistry I	**15 Lectures**	
VESUSCHP1	Chemistry Practicals **Practical's based on VESUSCH101 & VESUSCH102**	**02**	**06**

F.Y.B.Sc. (CHEMISTRY)

(SEMESTER II)

Course Code	Title	Credits & Lectures per Semester	Lectures per Week
VESUSCH201	**Chemistry Paper 01**	**02**	**03**
	Unit I Gaseous state Chemical Equilibrium and thermodynamic parameters	**15 Lectures**	
	Unit II Concept of Qualitative Analysis Acid Base Theories	**15 Lectures**	
	Unit III : Chemistry of Aliphatic Hydrocarbons	**15 Lectures**	
VESUSCH202	**Chemistry Paper 02**	**02**	**03**
	Unit I Ionic equilibria, Molecular Spectroscopy Solid State Chemistry	**15 Lectures**	
	Unit II Chemical bond and Reactivity Oxidation Reduction Chemistry	**15 Lectures**	
	Unit III: Stereochemistry II: Cycloalkanes and Conformational Analysis. Aromatic hydrocarbons	**15 Lectures**	
VESUSCHP2	Chemistry Practicals **Practical's based on VESUSCH201 & VESUSCHP202**	**02**	**06**

(SEMESTER I)

Detailed Syllabus: Unit wise / Module wise with number of lectures

Course title: Chemistry Paper 01

Course code: VESUSCH101

Objective: To understand the basic concepts of thermodynamics, atomic structure and nomenclature of organic compounds.

Learning Outcomes (LO):

On successful completion of this course students will be able to:

LO1 The students should be well acquainted with the fundamental topics in physical chemistry, inorganic chemistry, organic chemistry such as thermodynamics, Chemical kinetics, Understand the historical development of periodic table of elements & Periodicity, chemistry of the main group elements and their compounds, & the student must understand the nomenclature of organic compounds.

LO2 To learn the concept of thermodynamics with respect to first law of thermodynamics. To learn mole concept, concentration calculations and various stoichiometric relationships useful in quality control laboratories

LO3 Reinforce the historical development that lead to our modern knowledge of the structure of the atom.

LO4 Enable the students to describe the principle features of the modern periodic table.

LO5 To know the rules for converting names of organic compounds into their structures and vice versa.

LO6 To learn the appropriate geometry of organic molecules through the concept of hybridization

LO7 To learn the stability of organic reaction intermediates with the help of various electronic effects and their applications in studying organic reaction mechanism.

Course title: Chemistry Paper 01

Course code: VESUSCH101

Unit no.	Details of topics	No of lectures
1	**1.1 Thermodynamic terms:(10L)** System, surrounding, boundaries, open, closed and isolated system, intensive and extensive properties, state functions and path functions, zeroth law of thermodynamics First law of thermodynamics: concept of heat (q), work (w), internal energy (U), statement of first law, enthalpy, relation between heat capacities, sign conventions, calculations of heat (q), work (w), internal energy (U), and enthalpy (H) (Numericals expected) Thermochemistry: Heats of reactions, standard states, enthalpy of formation of molecules, enthalpy of combustion and its applications, calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equation **1.2 Chemical Calculations: (5L)** Expressing concentration of solutions: Normality, molality, molarity, formality, mole fractions, weight ratio, volume ratio, weight to volume ratio, ppm, ppb, millimoles,	15 Lectures

	milliequivalents (Numericals expected)	
2	**2.1 Atomic structure:** (Qualitative treatment only; it is expected that the learner knows the mathematical statements and understands their physical significance after completing this topic. No derivations of the mathematical equations required) a) Historical perspectives of the atomic structure; Rutherford's Atomic Model, Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Structure of hydrogen atom. b) Hydrogenic atoms: 1. Simple principles of quantum mechanics; **2.2 Atomic orbitals**: i) Hydrogenic energy levels ii) Shells, subshells and orbitals iii) Electron spin **2.3. Many Electron Atoms** i) Penetration and shielding ii) Effective nuclear charge 4. Aufbau principle **s block** introduction and its compounds with special reference to KOH, CsCl, BaSO4, KBr, LiOH/Cl, Beryllium compounds	15 Lectures
3	**Basics of Organic Chemistry** **3.1 Classification and Nomenclature of Organic Compounds: (5L)** Review of basic rules of IUPAC nomenclature. Nomenclature of mono and bi-functional aliphatic compounds on the basis of priority order of the following classes of compounds: alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines; including their cyclic analogues. **3.2 Bonding and Structure of organic compounds: (4L)** Hybridization: sp3, sp2, sp hybridization of carbon and nitrogen; sp3 and sp2 hybridizations of oxygen in Organic compounds (alcohol, ether, aldehyde, ketone, carboxylic acid, ester, cyanide, amine and amide) Overlap of atomic orbitals: Overlaps of atomic orbitals to form sigma and pi bonds, shapes of organic molecules. Shapes of molecules; Influence of hybridization on bond properties (as applicable to ethane, ethene, ethyne) **3.3 Fundamentals of organic reaction mechanism: (6L)** **Electronic Effects:** Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their strengths. **Bond fission:** Homolytic and Heterolytic fission with suitable examples. Electrophiles and Nucleophiles. **Types (primary, secondary, tertiary, allyl, benzyl), shape and their relative stability of reactive intermediates:** Carbocations, Carbanions,and Free radicals. **Introduction to types of organic reactions:** Addition, Elimination and Substitution reaction. (With one example of each)	15 Lectures

Course title: Chemistry Paper 02

Course code: VESUSCH102

Objective: To understand the basic concepts of Chemical Kinetics, Liquid State, Metallic and Nonmetallic compounds, Oxides of Nitrogen and Stereochemistry.

Learning Outcomes (LO):

On successful completion of this course students will be able to:

LO1 Students should be able to acquire scientific knowledge in a comprehensive manner and apply the skills acquired in various topics such as Chemical Kinetics, Chemical bond & reactivity as related stereochemistry

LO2 Concept of order and molecularity of a reaction and their determination.

LO3 Liquid crystals: classification, properties and their applications.

LO4 To study the properties of the metals and Nonmetals.
To study the preparation and properties of oxides of nitrogen.

LO5 To draw the configuration of organic molecules in various projection formulas and
Interconvert them.

LO6 To Identify the stereocenters in a molecule and assign the configuration as *D/L* and *R or S.*

Course title: Chemistry Paper 02

Course code: VESUSCH102

Unit no.	Details of topics	No of lectures
1	**1.1 Chemical Kinetics: (8L)** Rate of reaction, rate constant, measurement of reaction rates, order and molecularity of reaction, integrated rate equation of first and second order reactions (with equal initial concentration of reactants) (Numericals expected) Determination of order of reaction by (a) Integration method (b) Graphical method (c) Ostwald's isolation method (d) Half time method (Numericals expected) 1.2 **Liquid State: (7L)** Surface tension: Introduction, methods of determination of surface tension by drop number method (Numericals expected) Viscosity: Introduction, coefficient of viscosity, relative viscosity, specific viscosity, reduced viscosity, determination of viscosity by Ostwald viscometer (Numericals expected) Refractive index: Introduction, molar refraction and polarizability, determination of refractive index by Abbe's refractometer (Numericals expected) Liquid crystals: Introduction, classification and structure of thermotropic phases (Nematic, smectic and cholesteric phases), applications of liquid crystals	15 Lectures
	Comparative chemistry of Main group elements: Metallic and non-metallic nature, oxidation states, electronegativity, anomalous behaviour of second period elements, allotropy, catenation, diagonal relationship. oxides and hydroxides of group I and group II	15

2	elements. Some important compounds- NaHCO3, Na2CO3, NaCl, NaOH, CaO, CaCO3; oxides of carbon, oxides and oxyacids of nitrogen with respect to environmental aspects. **Oxides of nitrogen** with respect to preparation and structure of NO, NO_2, N_2O and N_2O_4	Lectures
3	**3. Stereochemistry I: (15L)** Fischer Projection, Newman and Sawhorse Projection formulae (of erythro, threo isomers of tartaric acid and 2,3 dichlorobutane) and their interconversions ; Geometrical isomerism in alkene and cycloalkanes: cis–trans and syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two similar and dissimilar chiral-centres, diastereoisomers, meso structures, racemic mixture & resolution (methods of resolution not expected). Relative and absolute configuration: D/L and R/S designations. Conformation analysis of alkanes (ethane, propane & n-butane); Relative stability with energy diagrams	15 Lectures

Course title: CHEMISTRY PRACTICALS

Course code: VESUSCHP101

Semester 01

Objective: To understand the basic concepts and techniques of chemistry practical's.

Learning Outcomes (LO):

On successful completion of this course students will be able to:

LO1 To learn to perform experiments that has specific aims with correct techniques.
LO2 To develop skills of observation, recording and analyzing data.
LO3 To learn to present the experimental work in a systematic manner

Unit no.	Details of topics	No of lectures
	Unit I: Physical Chemistry 1. To prepare 0.1 N succinic acid and standardize the NaOH of two different concentrations 2. To determine the rate constant for the hydrolysis of ester using HCl as catalyst 3. To determine enthalpy of dissolution of salt (like KNO_3) **Unit II: Inorganic Chemistry**. **1.** Commercial analysis of (any two) a) Mineral acid b) Organic acid c) Salt of weak acid and strong base. **2.** Titration using double indicator: analysis of solution of Na_2CO_3 and $NaHCO_3$. **3.** Gravimetric analysis a) To determine the percent purity of sample of $BaSO_4$ containing NH_4Cl b) To determine the percent purity of ZnO containing $ZnCO_3$. **Unit III: Organic Chemistry** 1. Purification of any three organic compounds by recrystallization selecting suitable solvent. (Provide 1g.). Learners are expected to report a) Solvent for recrystallization. b) Mass and the melting points of purified compound. Learners should calibrate thermometer before determining melting point. 2. Chromatography Separation of a mixture of o-and p-nitrophenols by thin layer chromatography (TLC)	

(SEMESTER II)

Course title: Chemistry Paper 01

Course code: VESUSCH201

Objective: To understand the basic concepts of gaseous state, chemical equilibrium, thermodynamics, qualitative analysis and aliphatic hydrocarbon.

Learning Outcomes (LO):

On successful completion of this course students will be able to:

LO1 The students should be well acquainted with the fundamental topics in physical chemistry, inorganic chemistry, organic chemistry

LO2 To study different gas laws, concept of compressibility factor and van der Waal's equation of state.

LO3 To study reversible and irreversible reactions, concept of Le Chatelier's principle.

LO4 To study qualitative analysis with reference to the role of impregnated test papers. To study the various theories of acid and base

LO5 To understand formation of organic compounds which involve cleavage and formation of sigma and pi bonds.

LO6 To study reactions of aliphatic hydrocarbon with their reaction mechanism

Course title: Chemistry Paper 01

Course code: VESUSCH201

Unit no.	Details of topics	No of lectures
1	**1.1 Gaseous State: (8L)** Ideal gas laws, kinetic theory of gases, Maxwell-Boltzmann's distribution of velocities (qualitative discussion), ideal gases, real gases, compressibility factor, Boyle's temperature (Numericals expected) Deviation from ideal gas laws, reasons for deviation from ideal gas laws, Van der Waals equation of state, Joule-Thomson effect: qualitative discussion and experimentation, inversion temperature. (Numericals expected) **1.2 Chemical Equilibria and Thermodynamic Parameters: (7L)** Reversible and irreversible reactions, law of mass action, dynamic equilibria, equilibrium constant, (Kc and Kp), relationship between Kc and Kp, Le Chatelier's principle, factors Affecting chemical equilibrium (Numericals expected) Statement of second law of thermodynamics, concepts of entropy and free energy, spontaneity and physical significance of free energy, thermodynamic derivation, equilibrium constant (numericals expected) Introduction to Third Law Of Thermodynamics	15 Lectures
	2.1 Concept of Qualitative Analysis: (7L)	

2	a) Testing of Gaseous Evolutes, Role of Papers impregnated with Reagents in qualitative analysis (with reference to papers impregnated with starch iodide, potassium dichromate, lead acetate, dimethylglyoxime and oxine reagents). b) Precipitation equilibria, effect of common ions, **Precipitation equilibria, effect of common ions Ni(DMG), Aluminium oxine reagents special reference to Gravimetry analysis** 2.2 Acid Base Theories: (8L) Arrhenius, Lowry- Bronsted, Lewis, Solvent – Solute concept of acids and bases, Hard and Soft acids and bases. Applications of HSAB Applications of acid base chemistry in: i) Understanding organic reactions like Friedel Craft's acylation/alkylation) reaction ii) Volumetric analysis with special reference to calculation of titration curve involving strong acid and strong base.	15 Lectures
3	**Chemistry of Aliphatic Hydrocarbons** **3.1 Carbon-Carbon sigma bonds: (4L)** **Chemistry of alkanes:** Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions. Free radical substitutions: Halogenation -relative reactivity and selectivity. **3.2 Carbon-Carbon pi bonds: (11L)** **Formation of alkenes and alkynes by elimination reactions:** Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. **Reactions of alkenes:** Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), Mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction(catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2-and 1, 4- addition reactions in conjugated dienes and, Diels-Alder reaction; **Reactions of alkynes:** Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes. Natural resources and applications of hydrocarbons	15 Lectures

Course title: Chemistry Paper 02

Course code: VESUSCH202

Objective: To understand the basic concepts of ionic equilibria, spectroscopy, solid state chemistry, chemical bond reactivity and stereochemistry.

Learning Outcomes (LO):

On successful completion of this course students will be able to:

LO1 To discern the concept of electrolytes, pH and its applications using Henderson equation for acidic and basic buffer solutions respectively

LO2 To have a clear idea of crystal structure, arrangement of constituent particles and their relevant properties

LO3 To classify various types of chemical bonding and identify the shapes of molecules using theories like valence bond theory, Sidgwick Powell theory, and VSEPR theory.

LO3 To introduce the concept of isoelectronic principle. To have an idea of balancing of redox equation.

LO4 To draw various conformations of alkanes and cycloalkanes and predict their relative stabilities.

LO5 To recognize and distinguish between aromatic and antiaromatic compounds by their structures.

LO6 To write the reactions and outline the mechanism of electrophilic aromatic substitution reactions.

Course title: Chemistry Paper 02

Course code: VESUSCH202

Unit no.	Details of topics	No of lectures
1	**1.1 Ionic equilibria (7L)** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water, ionization of weak acids and bases, pH scale, common ion effect, dissociation constants of mono-, di- and triprotic acid (exact treatment for monoprotic acid) Buffers: Introduction, types of buffers, derivation of Henderson equation for acidic and basic buffers, buffer action, buffer capacity (Numericals expected) **1.2 Molecular Spectroscopy: (4L)** Electromagnetic radiation, electromagnetic spectrum, Planck's equation, interaction of electromagnetic radiation with matter: Absorption, emission, scattering, flourescence, electronic, vibrational and rotational transitions, Beer-Lambert's law (Numericals expected)	15 Lectures

	1.3 Solid State Chemistry (4L) Types of solids, crystal lattice, lattice points, unit cell, space lattice and lattice plane, laws of crystallography: Law of constancy of interfacial angle, law of symmetry and law of rational indices (Numericals expected)	
2	**2.1 .Chemical Bond and Reactivity: (7L)** Types of chemical bond, comparison between ionic and covalent bonds, polarizability (Fajan's Rule), shapes of molecules, Lewis dot structure, Sidgwick Powell Theory, basic VSEPR theory for ABn type molecules with and without lone pair of electrons, isoelectronic principles, applications and limitations of VSEPR theory. 2.2: Oxidation Reduction Chemistry: (8L) a) Reduction potentials b) Redox potentials: half reactions; balancing redox equations. c) Redox stability in water i) Latimer and Frost Diagrams ii) pH dependence of redox potentials. d) Applications of redox chemistry i) Extraction of elements: (example: isolation of copper by auto reduction) ii) Introduction to titration and different methods and types of titrations	15 Lectures
3	**3.1 Stereochemistry-II: Cycloalkanes and Conformational Analysis: (5L)** Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy. **3.2Aromatic Hydrocarbons: (10L)** Aromaticity: Hückel's rule anti-aromaticity, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft alkylation/acylation with their mechanism. Hammond's postulate, Directing effects of the groups.	15 Lectures

Course title: CHEMISTRY PRACTICALS

Course code: VESUSCHP201

Semester 02

Objective: To understand the basic concepts and techniques of chemistry practical's.

Learning Outcomes (LO):

On successful completion of this course students will be able to:

LO1 To study the importance of MSDS.
LO2 To develop skills of observation, recording and analyzing data.
LO3 To learn to present the experimental work in a systematic manner

CHEMISTRY PRACTICALS

Semester 02

Unit no.	Details of topics	No of lectures
	Unit I: Physical Chemistry 1. To determine the rate constant for the saponification reaction between ethyl acetate and NaOH 2. To determine dissociation constant of weak acid (Ka) using Henderson's equation and the method of incomplete titration pHmetrically. 3. To verify Beer-Lambert's law, using KMnO4 solution by colorimetric method. 4. To standardize commercial sample of HCl using borax and to write material safety data of the chemicals involved. **Unit II: Inorganic Chemistry** Qualitative analysis: (at least 3 mixtures to be analyzed) Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions. Cations (from amongst): Pb^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Cu^{2+}, Cd^{2+}, Fe^{2+}, Ni^{2+}, Mn^{2+}, Mg^{2+}, Al^{3+}, Cr^{3+}, K^{+} ,NH_4^{+} Anions (From amongst): CO_3^{2-}, S_2^{-} , SO_3^{2-} , NO_2^{-} , NO_3^{-}, Cl^{-} , Br^{-} , I^{-} , SO_4^{2-} , PO_4^{3-} (Scheme of analysis should avoid use of sulphide ion in any form for precipitation / separation of cations.) 2. Redox Titration: To determine the percentage of copper(II) present in a given sample by titration against a standard aqueous solution of sodium thiosulfate (iodometry titration) **Unit III: Organic Chemistry** Characterization of organic compound containing C, H, (O), N, S, X elements. (minimum 7 compounds)	

References

REFERENCES THEORY

Reference Books:

Unit I: Physical Chemistry

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).

Unit II: Inorganic Chemistry

1. Puri, Sharma and Kalia, Milestone publishers, Principles of Inorganic Chemistry
2. J. D. Lee, 4th Edn., Concise Inorganic Chemistry, ELBS,
3. Cotton and Wilkinson, Advanced Inorganic Chemistry, 3rd. Edition.
4. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press (1999)
5. Per Jensen and Philip R. Bunker , Fundamentals of Molecular Symmetry , Series in Chemical Physics, Taylor & Francis Group
6. J. S. Ogden, Introduction to Molecular Symmetry, Oxford University Press
7. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd
8. C. N. R. Rao Advances in Solid State Chemistry
9. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
10. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.

Unit III: Organic Chemistry

1. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
4. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
6. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

REFERENCES PRACTICAL

Reference Books

Unit I: Physical Chemistry

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001).

Unit II: Inorganic Chemistry

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6 th Ed., Pearson, 2009.

Unit III: Organic Chemistry

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996

Modality of assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 25% marks in the first part & by conducting the Semester End Examinations with 75% marks in the second part. Practical Examination will consist of End Sem examination.

Student will have to score 40% of marks in Internal assessment as well as End Sem examination to pass the course.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

Internal Assessment: It is defined as the assessment of the learners on the basis of internal evaluation as envisaged in the Credit & Choice based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

Semester End Assessment: It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ written/ Practical examination.

A. Theory - Internal assessment 25% **25 marks**

Sr No	Evaluation type	Marks
1.	- Class Test (multiple choice questions/Match the following /True or False)	15
2.	- Assignments/ Reports / Presentations / Skit / Poster / etc.) - Active participation in routine class activity.	10

B. Theory - External examination - 75% **75 marks**

Semester End Theory Assessment

Duration - Each paper shall be of 2.5 hours' duration.

1. Theory question paper pattern :-
    a. There shall be FIVE compulsory questions.
    b. Question No 01 and Question No 05 will be based on Unit 01, 02 and 03
    c. Question No 01 will contain MCQ (any twelve out of eighteen) and True or False (any three out of six)
    d. Question No 2, 3 and 4 will be based upon Unit 01, Unit 02 and Unit 03 respectively.
    e. Question No 5 will contain Six questions.(Unit 1+Unit 02+Unit 03 Each Two Question)

Question no.	Details	Marks
Q1.	A. Fill in the blanks/ MCQ Attempt any twelve out of eighteen B. True or False Attempt any three out of six (Question No 01 will be based on Unit 01, 02 and 03)	**12** **3**
Q2.	**(Unit 01 Physical Chemistry)**	15M
	Attempt any three of the five A) B) C) D) E)	
Q3.	**(Unit 02 Inorganic Chemistry)**	15M
	Attempt any three of the five A) B) C) D) E)	
Q4	**(Unit 03 Organic Chemistry)**	15M
	Attempt any three of the five A) B) C) D) E)	
Q5	**Attempt any three of the following Six**	15M
	(Two Question from Each Unit) A) B) C) D) E) F)	

C. Semester End Practical Assessment **50 marks**

	Section 1 Based on Paper 1	**50 Marks**
A	Any one experiment	40
B	Viva	05
C	Journal	05
	Section 2 Based on Paper 2	**50 Marks**
A	Any one experiment	40
B	Viva	05
C	Journal	05

PRACTICAL BOOK/JOURNAL

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Coordinator / In-charge of the department; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

SEMESTER I

Course	**VESUSCH101**	**VESUSCH102**	**Grand Total**
Theory	**100**	**100**	**200**
Practical's	**50**	**50**	**100**

SEMESTER II

Course	**VESUSCH201**	**VESUSCH202**	**Grand Total**
Theory	**100**	**100**	**200**
Practical's	**50**	**50**	**100**