

Vivekanand College, Kolhapur (Autonomous)
Department of Chemistry
B.Sc. Part - I Draft Syllabus (CBCS Pattern)
W.E.F. from June -2021

INTRODUCTION

This syllabus is prepared to give the sound knowledge and understanding of chemistry to undergraduate students at first year of the B.Sc. degree course. The goal of the syllabus is to make the study of chemistry as stimulating, interesting and relevant as possible. The syllabus is prepared by keeping in mind the aim to make students capable of studying chemistry in academic and industrial courses. Also to expose the students and to develop interest in them in various fields of chemistry. The new and updated syllabus is based on disciplinary approach with vigour and depth taking care of the syllabus is not heavy at the same time it is comparable to the syllabi of other universities at the same level.

The syllabus is prepared after discussions of number of faculty members of the subject and by considering the existing syllabi of B.Sc. Part-I, II & III, XIth & XIIth standards, NET, SET examination, U.G.C. model curriculum, different entrance examinations, other Universities and other autonomous institutes.

The units of the syllabus are well defined and the scope is given in detail. The periods required for units are given. The lists of reference books are given in detail.

OBJECTIVES

To enable the students

- To promote understanding of basic facts and concepts in Chemistry while retaining the excitement of Chemistry.
- To make students capable of studying Chemistry in academic and Industrial courses.
- 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.
- To develop problem solving skills in students.
- To expose the students to different processes used in Industries and their applications.
- To develop ability and to acquire the knowledge of terms, facts, concepts, processes, techniques and principles of subjects.
- To develop ability to apply the knowledge of contents of principles of chemistry.
- To inquire of new knowledge of chemistry and developments therein.
- To expose and to develop interest in the fields of chemistry.
- To develop proper aptitude towards the subjects.
- To develop the power of appreciations, the achievements in Chemistry and role in nature and society.
- To develop interest in students to study chemistry as a discipline.
- To develop skills required in chemistry such as the proper handling of apparatus and chemicals.

List of Laboratory equipment & Chemicals required

Apparatus & equipments and chemicals required.

Viscometer	Measuring cylinder	Wire gauze	Burette stand
Stop watch	Stopper bottle	Burner	Iron stand
Eudiometer	Test tube, Beaker	Water bath	Test tube holder
Digital balance	Thile's tube	Chromatography paper	Test tube stand
Burette, pipette and conical flask	Capillary tube	Gas jar	Spot tile
1/100°C thermometer	Evaporating dish	Watch glass	Dropper
Polythene bottles	Glass rod	Tripod stand	Dryer

General Structure

There will be two theory papers each of 40 marks for each semester and internal examination of 10 marks.

Semester	Course Opted	Course Name	Credits
I	Ability Enhancement Compulsory Course (AECC)-I	English	4
	DSC-1002A-Paper-I	Inorganic Chemistry	2
	DSC-1002A-Paper-II	Organic Chemistry	2
II	Ability Enhancement Compulsory Course (AECC) -II	English	4
	DSC-1002B-Paper-III	Physical Chemistry	2
	DSC-1002B-Paper-IV	Analytical & Industrial Chemistry	2
I & II	Core Course- Practical	Chemistry Lab I: DSC-1002A Inorganic & Organic Chemistry	2
	Core Course- Practical	Chemistry Lab II: DSC-1002B Physical & Analytical Chemistry	2

There will be annual practical examination. Practical will be of 50 marks. Physical, Inorganic and Organic sections carry 15 marks each. Five marks are reserved for journal. The duration of practical examination will be of six hours.

Vivekanand College, Kolhapur (Autonomous)
B. Sc. Part-I (Chemistry) CBCS Syllabus with effect from June, 2021
Semester-I

DSC-1002A-Paper-I: Inorganic Chemistry
Theory: 30hr (37 Periods) Credits-2

(37 Periods)

Unit-I: Atomic Structure and Periodicity of Elements **(11 L)**

Bohr's theory of hydrogen atom and its limitations, Wave particle duality, Heisenberg uncertainty principle, Quantum numbers and their significance, Shapes of s, p and d atomic orbitals, Electrons filling rules in various orbitals: a) Aufbau's principle b) Hund's rule of maximum multiplicity c) Pauli's exclusion principle, Electronic configuration of elements. Stability of empty, half-filled and completely filled orbitals, Periodicity of the elements: General discussion of the following properties of the elements with reference to s block elements: a) electronic configuration b) atomic radii c) ionic radii d) ionization energy e) electron affinity f) electronegativity g) metallic characters h) reactivity i) oxidation state j) melting and boiling points k) chemical properties

Unit-II: Chemical Bonding and Molecular structure -Ionic Bonding **(9 L)**

Definition and formation of ionic bond. General characteristics of ionic bonding, Energetic in Ionic bond formation, Born-Haber cycle for NaCl and its applications, Fajan's Rule, Applications of Fajan's rule for,

- Polarizing power and polarizability
- Ionic character in covalent compounds
- Bond moment, dipole moment and percentage ionic character

Unit-III: Chemical Bonding and Molecular structure-Valence bond theory (VBT) **(8 L)**

Concept of hybridization, different types of hybridization and geometry of following molecules, Linear geometry- BeCl_2 (sp hybridization)

- Planer trigonal geometry- BF_3 (sp^2 hybridization)
- Tetrahedral geometry- SiCl_4 (sp^3 hybridization)
- Trigonal bipyramidal geometry- PCl_5 (sp^3d hybridization)
- Octahedral geometry- SF_6 (sp^3d^2 hybridization)
- Pentagonal bipyramidal geometry - IF_7 (sp^3d^3 hybridization)

Unit-IV: Chemical Bonding and Molecular structure (C) Molecular orbital theory (MOT)

(9 L)

LCAO method, formation of bonding, anti-bonding and nonbonding molecular orbitals, Conditions for successful overlap, Types of overlaps - S-S, S-px, Px-Px, Py-Py and Pz-Pz overlaps, Bond order and its significance, Energy level sequence for molecular orbital when $n=1&2$, MO diagrams for homonuclear diatomic molecule of 1st & 2nd period Elements (He_2 , Li_2 , B_2 , N_2 , O_2), Molecular orbital diagrams for heteroatomic diatomic molecules. (CO, NO)

Reference Books

- 1) Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
 - 2) Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
 - 3) Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
 - 4) Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
 - 5) Puri, Sharma, Kalia. *Principles of Inorganic Chemistry*
 - 6) Suratkar and Thatte. *Theoretical Inorganic Chemistry*
 - 7) Day and Sellbin. *Theoretical Inorganic Chemistry*
 - 8) R Gopalan & Ramalingum. *Coordination Chemistry*
 - 9) Satyaprakash, Tuli and Madan. *Advanced Inorganic Chemistry*
 - 10) Huheey, J. E. *Principles of Structure and Reactivity*.
 - 11) Huheey, J. E *Inorganic Chemistry*
 - 12) Gary Meissler and Donald Tarr. *Inorganic Chemistry*
 - 13) D.F.Shriver & P.W. Atkins *Inorganic Chemistry*
 - 14) E. S. Gilreath. *Fundamental Concepts of Inorganic Chemistry*
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Semester-I

DSC-1002A-Paper-II: Organic Chemistry
Theory: 30hr (38 Lectures) Credits-2

(38 Periods)

Unit-I: Fundamentals of Organic Chemistry **(10 L)**

Physical Effects, Electronic Displacements: Inductive Effect, Electrometric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases.

Unit-II: Stereochemistry **(10 L)**

Conformations with respect to ethane, butane and cyclohexane, Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations, Concept of chirality (upto two carbon atoms), Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis-trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems)

Unit-III: Aromaticity **(8 L)**

Introduction, Characteristics properties of organic compounds, Meaning of terms: Aromatic, Non aromatic, Antiaromatic, Pseudoaromatic, Structure of Benzene: Kekule structure, Resonance structure, M.O. picture, Modern theory of Aromaticity, Mechanism of Electrophilic substitution reactions: Nitration, Sulphonation, Halogenation and Friedel craft reaction

Unit-IV: Aldehydes and Ketones **(10 L)**

Preparation: Formaldehyde, acetaldehyde, acetone and benzaldehyde from acid chlorides and nitriles.

Reactions – Reaction with NH_2OH , LiAlH_4 , NaBH_4 , HCN , Grignard Reagents, Iodoform test, Aldol Condensation, Wittig reaction, Benzoin condensation, Meerwein-Ponndorf-Verley reduction.

Reference Books

- 1) Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
 - 2) McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
 - 3) Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
 - 4) Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
 - 5) Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
 - 6) Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
 - 7) Tiwari, Vishnoi Textbook of Organic Chemistry.
 - 8) R. K. Bansal Textbook of Organic Chemistry.
 - 9) E. S. Gould Mechanism and structure in organic chemistry.
 - 10) Bhal and Bhal Textbook of Organic Chemistry
 - 11) Jerry March Advanced Organic Chemistry
 - 12) Phatak, Mahagani, Modern Organic Chemistry
 - 13) G.R. Chatwal, reaction Mechanism and reagents in Organic Chemistry
 - 14) Stereochemistry by P. S. Kalsi (New Age International)
 - 15) Organic Chemistry- Clayden, Greeves, Warren.
 - 16) Reaction and rearrangement- S. N. Sanyal.
 - 17) Organic Reaction Mechanism- V. K. Ahluwalia.
 - 18) Advanced Organic Chemistry- Jagdamba Singh.
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Semester-II

DSC-1002B-Paper-III: Physical Chemistry
Theory: 30hr (38 Lectures) Credits-2

Unit-I: Chemical Energetics **(14 L)**

A) Thermodynamics

Introduction, Basic concepts of thermodynamics, Zeroth law, First law of thermodynamics, Spontaneous and non-spontaneous process with examples, Statements of second law of thermodynamics, Carnot's cycle and its efficiency. Entropy, Physical Significance of entropy, Statement of Third Law of thermodynamics and calculation of absolute entropies of substances, Numerical problems.

B) Thermochemistry

Introduction, Enthalpy of reaction, standard enthalpy changes, various types of enthalpy changes viz, enthalpy of formation, enthalpy of neutralization, enthalpy of ionization, enthalpy of solution (integral and differential enthalpy of solutions), enthalpy of hydration, enthalpy of phase transitions; Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation, Numerical problems.

Unit-II: Chemical Equilibrium **(10 L)**

Concept of free energy, Free energy change in a chemical reaction, Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^0 , LeChatelier's principle, Condition for maximum yield in industrial processes like manufacture of ammonia, and sulphuric acid, Relationships between K_p , K_c and K_x for reactions involving ideal gases, Numerical problems.

Unit-III: Chemical Kinetics

(7 L)

Introduction, Rate of reaction, Definition and units of rate constant, Factors affecting rate of reaction. (Nature of reactant, Concentration, pressure, temperature and catalyst.) Order and Molecularity of reaction, Zero order reaction, First order reaction, Characteristics of first order reaction. examples, Pseudo-unimolecular reactions, Numerical problems.

Unit-IV: Distribution law

(7 L)

Introduction, solute, solvent and solution, miscible and immiscible liquids, Nernst distribution law and its limitations, Modification of distribution law with respect to change in molecular state of solute (association and dissociation of solute in one of the solvents), Numerical problems.

Applications of the distribution law

- i. Process of extraction (derivation expected).
- ii. Determination of solubility of solute in particular solvent.
- iii. distribution indicators.
- iv. determination of molecular weight of solute in different solvents.

Reference Books

- 1) Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- 2) Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- 3) Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- 4) Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
- 5) Puri, Sharma, Pathania. *Principles of Physical Chemistry*.
- 6) *Principles of Physical Chemistry* by murrone prutton.
- 7) S.K. Dogra and Dogra. *Physical Chemistry*
- 8) Engel and Red, *Principles of Thermodynamics*
- 9) Peter and Atkins. *Physical Chemistry*
- 10) Glasston and Levis *Principle of Physical Chemistry*
- 11) Bhal & Tuli, *Physical Chemistry*

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Semester-II

DSC-1002B-Paper-IV: Analytical & Industrial Chemistry
Theory: 30hr (37 Lectures) Credits-2

Unit-I: Introduction to Analytical & Industrial Chemistry (12 L)

A. Introduction, difference between classical chemistry and industrial chemistry, Importance of analysis, Analytical processes (Qualitative and Quantitative), Methods of analysis (Only classification), Sampling of solids, liquids and gases; Errors, types of errors (determinate and indeterminate), methods of expressing accuracy (Absolute and relative error), Significant figures, mean, median, standard deviation (Numerical problems expected)

B. Explanation of terms and numerical problems- Normality, Equivalent weight, Molality, Molecular weight, Molarity, Molarity of mixed solution, Acidity of base, Basicity of acid, ppt, ppm, ppb solutions, Mole Fraction, Weight fraction, Percentage composition by W/W, W/V, V/V.

C. Safety symbols in chemistry, First aid measures in the laboratory, Material Safety data sheets.

Unit-II: Theory of titrimetric Analysis (8 L)

Introduction, Acid-base indicators, Theory of indicators w. r. t. Ostwald's ionization theory and quinoid theory, Neutralization curves and choice of indicators for: a) Strong acid-strong base b) Strong acid-weak base c) Strong base-weak acid d) Weak base-weak acid. Complexometric titrations: Introduction, Types EDTA titrations, Metallochromic indicators-Eriochrome black- T, Indicator Action of Eriochrome black- T.

Unit-III: Chromatography (8 L)

Introduction, Basic Principle of Chromatography, Basic terms, Classification of Chromatography

A. Paper Chromatography: Principle, Methodology-types of papers and treatment, sample loading, choice of solvent, development-ascending, descending, circular,

location of spots, determination of Rf value, Applications, advantages and disadvantages

B. Thin layer chromatography: Principle, Solvent system, stationary phases, preparation of TLC plate, Detecting reagents, methodology-sample loading, development, detection of spot, Rf value, Applications, advantages and disadvantages. Comparison of paper chromatography and TLC

Unit-IV: Dairy Chemistry (5 L)

Introduction, constituents of milk and their physicochemical properties, chemical change taking place in milk due to processing parameters- boiling, pasteurization, sterilization and homogenization. Definition and composition of creams, butter, ghee and ice-creams. Milk powder-definition, need for making powder.

Unit-V: Food Industry (5 L)

Introduction, scenario of Indian food industries, raw materials and processes. Food processing and preservation operations: cold preservation, Freezing, Dehydration, irradiation.

B.Sc. Part I, Sem I & II Examination Pattern

For B.Sc. I Chemistry Theory Exam

Sr. No.	Internal Examination DSC Course				Total (a+b+c+d)	Conversion of 80 marks in Total (I) (e)	SEE (Semester End Examination) DSC Course		Total (II) (f+g)= h	Total (I and II) (e+h) = i
	Paper-I (Two tests each of 10 marks) (a)	Paper- II (Two tests each of 10 marks) (b)	Home assignm ent Paper I (c)	Home assignm ent Paper II (d)			Paper-I (f)	Paper- II (g)		
1	20	20	20	20	80	20	40	40	80	100

Nature of Internal and SEE (Semester End Examination) Examination

- 1) For internal examination, there shall be two tests (online/offline) of ten marks and one home assignment of 20 marks for each paper per semester.
- 2) For internal examination there shall be conversion of 80 marks in 20 marks and for passing 7 marks is required out of 20.
- 3) For SEE (Semester End Examination), there shall be two papers (Paper I and Paper II) of each DSC course per semester, each of 40 marks.
- 4) There shall be combined passing for SEE (Semester End Examination) of Paper-I and Paper-II i.e. 28 marks is required out of 80.
- 5) There shall be separate passing mandatory for both internal and SEE (Semester End Examination).
- 6) The practical exam shall be conducted annually for 50 marks.

B.Sc. I Practical Examination

Sr. No.	Physical Chemistry	Inorganic Chemistry	Organic Chemistry	Journal	Total
1.	15	15	15	5	50

Nature of Question Paper
B.Sc. I. Semester: I & II
Paper- I, II, III, IV

Time: 2 hours

Total Marks: (40)

Instructions:

- (1) **All** questions are **compulsory**.
- (2) Figures to the **right** indicate **full** marks.
- (3) Draw **neat** labeled diagrams **wherever** necessary.
(Paper setter may add or delete any instruction if required)

Q.1. Select correct alternative.

(8)

- (i)-----
a) b) c) d)
- (ii)-----
a) b) c) d)
- (iii)-----
a) b) c) d)
- (iv)-----
a) b) c) d)
- (v)-----
a) b) c) d)
- (vi)-----
a) b) c) d)
- (vii)-----
a) b) c) d)
- (viii)-----
a) b) c) d)

Q. 2. Attempt any two

(16)

- (i)
- (ii)
- (iii)

Q.3. Attempt any four

(16)

- (i)
- (ii)
- (iii)
- (iv)
- (v)
- (vi)

B. Sc. I

Syllabus for Practical Chemistry DSC-1002A and DSC-1002B

Section-I: Inorganic Chemistry

- To prepare standard 0.1 N KMnO_4 solution and to determine the strength of given oxalic acid solutions.
- To determine quantity of Fe (II) ions from the given solutions by titrating it with 0.1N $\text{K}_2\text{Cr}_2\text{O}_7$ solutions by using internal indicator.
- Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method.
- Water analysis: To determine the alkalinity of water sample by using Phenolphthalin and Methyl Orange Indicator
- To estimate amount of Cu (II) ions by iodometric titration by using $\text{Na}_2\text{S}_2\text{O}_3$ solution
- **Spot Tests**
Detection of following cations using spot tests: Cu^{2+} , Co^{2+} , Ni^{2+} , Fe^{3+} , Al^{3+} , Zn^{2+} , Mg^{+2} , Pb^{2+}
- **Paper Chromatography**
Detection of following cations using Paper Chromatography: $\text{Cu}^{2+} + \text{Co}^{2+}$, $\text{Co}^{2+} + \text{Ni}^{2+}$, $\text{Ni}^{2+} + \text{Cu}^{2+}$

Section-II: Organic Chemistry

- Organic Spotting – (6)
- Estimation of Aniline/Phenol
- Estimation of Aspirin from given pharmaceutical tablet.
- Preparation and purification of acetanilide from aniline.
- Preparation of m-dinitro benzene from nitrobenzene.

Section-III: Physical Chemistry

- To study the reaction rate of hydrolysis of methyl acetate in presence of 0.5N HCl.
- To determine viscosity of given liquid A and B.
- Determination of enthalpy of ionization of acetic acid.
- Determination of enthalpy of neutralization of HCl with NaOH
- Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps using pH-meter.
- To prepare and measure pH of buffer solutions ($\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$) by potentiometer.
- To determine equivalent weight of Mg by Eudiometer.

Reference Books

- 1) Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- 2) Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- 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.
- 4) Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- 5) Khosla, B. D.; Garg, V. C. and Gulati, A. *Senior Practical Physical Chemistry*, S. Chand & Company, New Delhi, 2011.
- 6) Nadkarni, Kothari and Lavande *Practical Book of Physical Chemistry*
- 7) Findley A., *Experimental Physical Chemistry*
- 8) Das, R. C., B, Behra, *Experiments in Physical Chemistry*
- 9) Yadav J. B. *Advance Practical Physical Chemistry*
- 10) Clarke *Handbook of Organic Quantitative Analysis*
- 11) Ahluvalia V. K., *Comprehensive Practical Organic Chemistry*
- 12) Kulkarni, V. S., Dastane, R. *Laboratory Handbook of Organic Qualitative Analysis and Separation*
- 13) Khopkar, S. M., *Basic Concepts in Analytical Chemistry*