



Solapur University,
Solapur

B. Sc.-I (Chemistry)
CHOICE BASED CREDIT SYSTEM
(CBCS)
Syllabus- 2016

SOLAPUR UNIVERSITY, SOLAPUR
SYLLABUS FOR B. Sc – I (CHEMISTRY)
CHOICE BASED CREDIT SYSTEM (CBCS) SYLLABUS

Structure of the Course:

- Structure of B.Sc. course in faculty of science has total of 06 semesters for 3 years.
- B.Sc.-I comprises of total two semesters. Each semester will have **two** theory papers of 70 marks for university external examination and 30 marks for internal examination for each paper.
- At the end of academic year i.e. semester II the practical examination will be conducted. The Weightage of practical is of 70 marks for university external practical examination and 30 marks for internal practical examination.
- The titles and marks distribution for each paper are as under.

| Semester | Paper No. | Title of Paper | Total Lectures | Examination | | | Total Credit |
|-------------|-----------|----------------------|----------------|-------------|---------------|-------------|--------------|
| | | | | Univ. Exam | Internal Exam | Total Marks | |
| Semester I | I | Physical Chemistry | 45 | 70 | 30 | 100 | 2.5 |
| | II | Inorganic Chemistry | 45 | 70 | 30 | 100 | 2.5 |
| Semester II | III | Organic Chemistry | 45 | 70 | 30 | 100 | 2.5 |
| | IV | Analytical Chemistry | 45 | 70 | 30 | 100 | 2.5 |
| Practical | I | Chemistry | | 70 | 30 | 100 | 04 |

- **University Examination**

1. Theory Paper I : 70 Marks
2. Theory Paper II : 70 Marks
3. Practical : 70 Marks

Practical paper has 70 marks for external university practical examination. Duration of practical examination is **one day**. There will be three practicals, one from each sections physical, inorganic and organic chemistry. Out of 70 marks for external university practical examination, the mark distribution is as follows.

- Q. 1 Physical Chemistry experiment : 20 marks
- Q. 2 Inorganic Chemistry experiment : 20 marks
- Q. 3 Organic Chemistry experiment : 20 marks
- Q. 4 Oral : 05 marks
- Q. 5 Journal : 05 marks

 Total marks : 70 marks

- **Continuous Internal Assessment for chemistry:**

- 1) Each theory paper has 30 marks for internal examination. There will be 15 marks for unit test and 15 marks for home assignment.
- 2) Practical paper has 30 marks for internal examination.

SEMESTER-I
PAPER –I (Physical Chemistry)
(Total Credits: 2.5; Contact hrs: 45)

1. Chemical Kinetics **(Contact hrs: 20)**

- 1.1 Chemical Kinetics and its scope, Rate of reaction, Definition and units of rate constant.
Factors affecting rate of reaction. Concentration, pressure, temperature and catalyst.
- 1.2 Order and Molecularity of reaction.
- 1.3 First order reaction: Derivation of Rate constant. Characteristics of first order reaction.
Examples: Decomposition of N_2O_5
- 1.4 Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants. Characteristics of Second order reaction.
Examples : i) Reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI .
- 1.5 Pseudo-unimolecular reactions such as Hydrolysis of methyl acetate in presence of Acid.
- 1.6 Methods to determine the order of reaction:
- | | |
|------------------------|-------------------------------|
| a) Integration method, | b) Graphical method |
| c) Half change method, | d) Ostwald's isolation method |
- (Numerical Problems Expected)

2. Mathematical Concepts **(Contact hrs: 07)**

- 2.1 Graphical representation : Graph paper, co-ordinates of a point, equation of straight line and intercept, plotting of graph based on experimental data.
- 2.2 Derivative : Rules of differentiation (without proof) pertaining to algebraic and exponential functions. Example related to chemistry.
- 2.3 Integration : Rules of Integration (without proof) pertaining to algebraic and exponential functions. Example related to chemistry.
(Numerical Problems not expected)

3. Thermodynamics: **(Contact hrs: 06)**

- 3.1 Spontaneous and non spontaneous processes, Second law of thermodynamics and its different statements.
- 3.2 Carnot's Theorem (Heat engine), Carnot cycle and its efficiency.
(Numerical Problems Expected)

4. Gaseous State: **(Contact hrs: 12)**

- 4.1 a) Ideal and Non ideal gases, b) Deviation from ideal behaviour. (Only Boyle's law)
c) Causes of deviation, van der Waal's equation, explanation of real gas behavior by van der Waal's equation.
- 4.2 Critical Phenomena : PV-Isotherms of real gases (Andrew's isotherms), continuity of state, Relationship between critical constants and van der Waal's constants.
- 4.3 Liquification of gases, Joule-Thomson effect.
(Numerical Problems expected)

Reference Books:

- 1) Mathematical preparation of Physical Chemistry : F. Daniel Mc-Graw Hill Book Com.
- 2) Elements of Physical Chemistry : S. Glasstone and D. Lewis (D. Van Nostrand Co. Inc)
- 3) Physical Chemistry : W. J. Moore (Orient Longman)
- 4) Principles of Physical Chemistry : Maron Prutton

- 5) University Chemistry : B. H. Mahan (Addision - Weseley Publ. Co.)
- 6) Chemistry Principle & Applications : P.W. Atkins, M. J. Clugsto, M.J. Fiazer, R. A. Y. Jone (Longman)
- 7) Physical Chemistry : G. M. Barrow (Tata Mc-Graw Hill)
- 8) Essentials of Physical Chemistry : B. S. Bahl & G.D. Tuli (S. Chand)
- 9) Physical Chemistry : A. J. Mee.
- 10) Physical Chemistry : Daniels - Alberty.
- 11) Principles of Physical Chemistry : Puri - Sharma (S. Nagin)
- 12) Text Book of Physical Chemistry : Soni Dharmarha
- 13) University General Chemistry : CNR. Rao (McMillan)
- 14) Chemistry : Sienko - Plane (Recent Edn.,)
- 15) Physical Chemistry Through problems : Dogra and Dogra (Wiley Eastern Ltd.,)
- 16) Physical Chemistry : S. Glasstone.
- 17) Basic Chemical Thermodynamics : V. V. Rao.

SEMESTER-I
PAPER –II (Inorganic Chemistry)
(Total Credits: 2.5; Contact hrs: 45)

1. Atomic Structure and periodic properties (Contact hrs: 06)

1.1 Atomic Structure

- a) Shapes of s, p, d orbitals.
- b) Aufbau and Pauli's exclusion principle, Hund's rule of maximum multiplicity
- c) General electronic configuration of s and p block elements.

1.2 General Characteristics of s and p block elements w.r.t. Atomic and Ionic radii, Ionization energy, Electron affinity, Electronegativity, Reactivity, Melting and Boiling point

2. Chemical bonding and Ionic Solids (Contact hrs: 13)

2.1 Types of chemical bonding

2.2 Ionic Bonding

- a) Formation of ionic bond, Energetics of ionic bonding : Ionisation potential, Electron affinity and Lattice energy.
- b) Characteristics of ionic compounds.
- c) Born-Haber Cycle for Alkali metal halide (NaCl).
- d) Fajan's rules.

2.3 Radius ratio and crystal structure.

- a) Definition: Radius ratio (r^+ / r^-), Coordination number, Stoichiometry and unit cell.
- b) Concept and calculation of radius ratio (r^+ / r^-) for ionic solid with octahedral geometry.
- c) Radius ratio effect on geometry.
- d) Crystal structure of NaCl and CsCl w.r.t. unit cell, radius ratio, coordination number and stoichiometry.

3. Covalent bonding: Valence Bond Theory (VBT) Approach (Contact hrs: 13)

3.1 Valence Bond Theory: Heitler–London Theory and Pauling-Slater Theory

3.2 Limitations of VBT

3.3 Need of Hybridization

3.4 Types of hybridization and shapes of simple inorganic molecules: BeCl_2 , BF_3 , SiCl_4 , PCl_5 , SF_6 , IF_7 .

3.5 Valence Shell Electron Pair Repulsion (VSEPR) Theory w.r.t. NH_3 , H_2O , ClF_3

4. Covalent bonding: Molecular Orbital Theory (MOT) Approach (Contact hrs: 13)

4.1 Atomic and Molecular orbitals.

4.2 L.C.A.O. Principle

4.3 Bonding, Antibonding and Nonbonding Molecular orbitals.

4.4 Conditions for successful overlap

4.5 Different types of overlap (s-s, s-px, px - px and py- py or pz- pz)

4.6 Energy level sequence of molecular orbitals for $n = 1$ and $n = 2$

4.7 M. O. Diagrams for: a) Homonuclear diatomic molecule. H_2 , Li_2 , Be_2 , C_2 , N_2 and O_2

- b) Heteronuclear diatomic molecules CO and NO w.r.t. bond order stability and magnetic properties.

Reference Books:

- 1) Advanced Inorganic Chemistry - Cotton and Wilkinson
- 2) Inorganic Chemistry - J. E. Huheey
- 3) Concepts and models of Inorganic Chemistry - Douglas & McDaniel
- 4) Principles of Inorganic Chemistry - Puri, Sharma
- 5) New Concise Inorganic Chemistry - (ELBS) - J. D. Lee
- 6) Text book of Inorganic Chemistry - P. L. Soni
- 7) Advanced Inorganic Chemistry - Satyaprakash, Tuli, Basu
- 8) Theoretical Principles of Inorganic Chemistry - G. S. Manku
- 9) Principles of Inorganic Chemistry - Puri, Sharma & Kalia
- 10) Inorganic chemistry: Principles of structure and reactivity – J. E. Huheey
- 11) Advanced Inorganic Chemistry, Vol. I – Gurudeep Raj
- 12) A New Guide to Modern Valency Theory- G. J. Brown

SEMESTER-II
PAPER III: (Organic Chemistry)
(Total Credits: 2.5; Contact hrs: 45)

1. Fundamentals of organic reaction mechanism **(Contact hrs: 07)**

- 1.1 Meaning of reaction mechanism.
- 1.2 Curved arrow notation, Half headed and double headed arrows.
- 1.3 Types of bond breaking : Homolytic and Heterolytic.
- 1.4 Types of reagents : Electrophilic and Nucleophilic.
- 1.5 Types and sub-types of following organic reactions with definition and at least one example of each. a) Substitution b) Addition c) Elimination d) Rearrangement.
(Mechanism is not expected)
- 1.6 Reactive Intermediates with examples carbocations, carbanions (formation, structure, stability and reactions are expected). Carbon free radicals, carbenes, arenes, nitrenes
(Definition with example only)

2. Structure and Bonding **(Contact hrs: 07)**

- 2.1 Hybridization: sp^3 , sp^2 and sp w.r.t. methane, ethylene and acetylene respectively.
- 2.2 Bond length, Bond angle and Bond energy with factors affecting these properties
w.r.t. : sp^3 , sp^2 and sp hybridization
- 2.3 Resonance effect with respect to phenol, and nitrobenzene.
- 2.4 Hyperconjugation w.r.t. toluene.
- 2.5 Inductive effect, + I and - I .
- 2.6 Steric effect w.r.t. mesitoic acid.

3. Alkanes and Cycloalkanes **(Contact hrs: 07)**

- 3.1 Alkanes : Methods of formation with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acid.
- 3.2 Mechanism of free radical halogenation of alkanes.
- 3.3 Cycloalkanes - Nomenclature methods of formation
 - (a) Internal Wurtz reaction
 - (b) Distillation of calcium or barium salt of dicarboxylic acid.
- 3.4 Chemical properties of cyclopropane
 - (i) Free radical substitution of chlorine in presence of light.
 - (ii) Action of HBr and conc. H_2SO_4 iii) Catalytic reduction by H_2/Ni

4. Alkenes, Dienes and Alkynes **(Contact hrs: 09)**

- 4.1 Nomenclature of alkenes.
- 4.2 Methods of formation of alkenes with mechanism
 - i) By dehydration of lower alcohols.
 - ii) By dehydrohalogenation of lower alkyl halides.
- 4.3 Chemical reactions of alkenes - Hydrogenation, Electrophilic and free radical additions, Hydroboration, Oxidation, Epoxidation, Ozonolysis, Hydration, Hydroxylation, Oxidation with $KMnO_4$, Polymerisation of alkenes - ethylene and propylene
- 4.4 Nomenclature and classification of dienes.
- 4.5 Isolated, Conjugated and cumulated dienes.
- 4.6 Butadiene-Methods of formation, polymerisation, 1:2 and 1:4 additions and Diels-Alder reaction.
- 4.7 Alkynes - Nomenclature, Acidity of alkynes.

4.8 Electrophilic and Nucleophilic addition reactions, Hydroboration, oxidation.

5. Stereochemistry of organic compounds (Contact hrs: 07)

5.1 Types of stereo-isomerism - Optical isomerism, Geometrical isomerism and Conformational isomerism.

5.2 Chiral center [Explanation with lactic acid]

5.3 Elements of symmetry

5.4 Optical isomerism in lactic acid, tartaric acid and 2,3 - dihydroxy butanic acid

5.5 Enantiomers and diastereoisomers.

5.6 Racemic modification.

5.7 Geometrical isomerism-cause of geometrical isomerism.

5.8 Geometrical isomerism w.r.t. C = C

Geometrical isomerism in maleic acid and fumaric acid.

6. Aromaticity and Benzene (Contact hrs: 08)

6.1 Meaning of the terms - Aromatic, non-aromatic, antiaromatic and pseudoaromatic compounds.

6.2 a) Kekule structure of benzene

b) Resonance structures of benzene.

c) Molecular orbital picture of benzene.

d) Representation of benzene ring.

6.3 Modern theory of aromaticity. Fundamental Concepts - delocalisation of electrons, coplanarity and Huckel's $(4n + 2) \pi$ rule. Applications of Huckel's rule to naphthalene, pyrrole and pyridine.

6.4 Mechanism of electrophilic aromatic substitution in benzene w.r.t. nitration, sulphonation, halogenation and Friedel - Craft's reaction- alkylation and acylation.

Reference Books

1) Organic Chemistry : Hendrickson, Cram, Hammond.

2) Organic Chemistry : Morrison and Boyd

3) Organic Chemistry : Volume I and II I.L. Finar

4) Organic Chemistry : Pine

5) Advanced Organic Chemistry : Sachinkumar Ghosh

6) Advanced Organic Chemistry : B.S. Bahl and Arun Bahl

7) A Guide book to Mechanism in organic Chemistry : Peter Sykes

8) Stereochemistry of Organic Chemistry : Kalsi,

9) Stereochemistry of Carbon Compounds : Eliel

10) Text book of Organic Chemistry : P. L. Sony

11) Practical Organic Chemistry : By A. I. Vogel

12) Advanced Organic Chemistry - Reactions, Mechanism and Structure : Jerry March

13) Organic Chemistry : M.R. Jain

14) Organic Chemistry : J. M. Shaigel

SEMESTER-II
PAPER IV: (Analytical Chemistry)
(Total Credits: 2.5; Contact hrs: 45)

1. Physical properties of liquids **(Contact hrs: 15)**

- 1.1 Introduction, additive and constitutive properties
- 1.2 Viscosity, coefficient of viscosity, determination of viscosity by Ostwald's Viscometer
- 1.3 Surface tension:- Determination of surface tension by Drop –Weight method
- 1.4 Parachor:-Macleod equation and its modification by Sugden, applications of parachor in the determination of molecular structures as benzene and NO₂ group
- 1.5 Dipole moment, electrical polarization of molecules
- 1.6 Use of dipole moment in the study of molecular structure
- 1.7 Refractive index, Snell's law
- 1.8 Specific and molecular refractivity, Abbe's refractometer: Principle-critical angle phenomenon-construction, working and advantages
- 1.9 Molecular refractivity and chemical constitution.

2. Environmental Chemistry: Air pollution **(Contact hrs: 07)**

- 2.1 Introduction: Meaning of terms: Environment, Pollution, Pollutant, Threshold Limit Value (TLV), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD)
- 2.2 Types of Pollution (Only Introduction): Air pollution, Water pollution, Sound pollution, Soil pollution, Automobile pollution and nuclear pollution.
- 2.3 Air Pollution: Classification of Air pollutants, Oxides of carbon, Sulphur and Nitrogen as air pollutants with respect to source and health hazards.

3. Environmental Chemistry: Water pollution **(Contact hrs: 08)**

- 3.1 Introduction: Resources of water, Types of water Pollutants, water Pollution and its sources (Brief Account)
- 3.2 Treatment of water:
 - A) Potable Water: Parameters of potability of water
 - Step I: Removal of suspended matter :
 - a) Prolonged storage
 - b) Screening
 - c) Sedimentation
 - d) Coagulation
 - e) Filtration
 - Step II: Removal of germs and bacteria- Physical and Chemical method.
 - Physical Methods :
 - a) Boiling
 - b) Exposure to UV or Sunlight
 - c) Distillation.
 - Chemical Method :
 - a) Chlorination
 - b) Fluorination
 - c) Ozonisation
 - d) Aeration
 - e) Use of KMnO₄
 - B) Industrial Water: Mention names of the methods only, Ion exchange method in detail.
 - C) Municipal Sewage: Meaning of Sewage; mention the names of methods; activated sludge process in detail.

4. Qualitative and Quantitative elemental analysis

(Contact hrs: 08)

4.1 Qualitative analysis of Carbon, Hydrogen, Nitrogen & Sulphur

4.2 Quantitative analysis of -

- i) Carbon and hydrogen by Combustion method
- ii) Nitrogen by Kjeldahl's method
- iii) Halogen and Sulphur by Carius method.

4.3 Determination of molecular weight of an acid by titration method.

4.4 Empirical formula and molecular formula determination. (Numerical Problems Expected)

5. Petroleum and petrochemicals

(Contact hrs: 07)

5.1 Constituents and refining of petroleum, cracking, knocking, octane, hydro-forming

5.2 Synthesis and Industrial applications of following petrochemicals:

- a) Ethylene oxide
- b) Adipic acid
- c) Styrene
- d) 2-Phenyl ethanol
- e) Paracetamol

Reference Books

- 1) Chemistry - Central Science, Brown, Lemay, Bursten 8th Edition.
- 2) Principles of Physical Chemistry - S.H. Maron / C.F. Prutton
- 3) Elements of Physical Chemistry - P. Atkins / J. Paula
- 4) Essentials of Physical Chemistry - A. Bahl / B. Bahl / G. Tuli
- 5) Textbook of Physical Chemistry - S. Glasstone
- 6) Principles of Physical Chemistry - B. Puri / L. Sharma / M. Pathania
- 7) Textbook of Physical Chemistry - P. Soni / O. Dharmarha
- 8) Environmental Chemistry - A.K. De
- 9) Environmental pollution analysis - S.M. Khopkar
- 10) Organic Chemistry : Hendrickson, Cram, Hammond.
- 11) Organic Chemistry : Morrison and Boyd
- 12) Organic Chemistry : Volume I and II I.L. Finar
- 13) Organic Chemistry : Pine
- 14) Advanced Organic Chemistry : Sachinkumar Ghosh
- 15) Advanced Organic Chemistry : B.S. Bahl and Arun Bahl
- 16) Practical Organic Chemistry : By A. I. Vogel
- 17) Industrial Chemistry : Rogers
- 18) Industrial Chemistry : R.K. Das
- 19) Industrial Chemistry : B. K. Sharma

B.Sc. – I (Chemistry Practical Course)

Total Credits: 4
Marks: 100 (70+30)

- N.B.** i) Use of Digital balance is allowed.
ii) Use S.I. Units Wherever Necessary.

A) Physical Chemistry.

- 1) Determination of viscosity of given liquids A and B. (Density data of liquids, viscosity of water to be given.) [Any two liquids from, Acetone, CCl_4 , Ethyl alcohol, Ethylene glycol and n- propyl alcohol]
- 2) Determination of equivalent weight of Mg by Eudiometer.
- 3) Study of specific reaction rate of hydrolysis of methyl acetate in presence of HCl.
- 4) Study of specific reaction rate of hydrolysis of methyl acetate in presence of H_2SO_4
- 5) Study of reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI (Equal Concentrations)
- 6) Determination of heat of ionization of weak acid.

Reference Books :

- 1) Practical book of Physical Chemistry : Nadkarni, Kothari & Lawande.
- 2) Experimental Physical Chemistry : A. Findlay.
- 3) Systematic Experimental Physical Chemistry : S.W. Rajbhoj, Chondhekar (Anjali Pub.)
- 4) Experiments in Physical Chemistry : R.C.Das and B. Behra. (Tata Mc. Graw Hill)
- 5) Advanced Practical Physical Chemistry : J. B. Yadav (Goel Publishing House)
- 6) Practical Physical Chemistry : B. D. Khosala (R. Chand & Sons.)
- 7) Experiments in Chemistry : D. V. Jagirdar

B) Inorganic Chemistry

1) Inorganic Quantitative Analysis: Volumetric Analysis

- i) To prepare a standard solution of Oxalic acid and determine the strength of Sodium hydroxide solution in terms of normality and Kg/dm^3
- ii) To prepare a standard solution of Oxalic acid and determine the strength of Potassium permanganate solution in terms of normality and Kg/dm^3
- ii) To prepare standard solution of Potassium dichromate and determine strength of Ferrous Ammonium Sulphate solution in terms of normality and Kg/dm^3 (Use internal indicator)

2) Qualitative Analysis:

- 1) Spot Tests: Detection of following cations using spot tests : Cu^{2+} , Co^{2+} , Ni^{2+} , Fe^{3+} , Zn^{2+} , Mg^{2+} , Al^{3+} , Pb^{2+} .
- 2) Chromatography: Separation and identification of cations by Paper Chromatographic technique from the following mixtures :
 - a) $\text{Ni}^{2+} + \text{Cu}^{2+}$
 - b) $\text{Ni}^{2+} + \text{Co}^{2+}$
 - c) $\text{Cu}^{2+} + \text{Co}^{2+}$

Reference Books :

- 1) Vogel's Text Book of Quantitative Chemical Analysis (Longman ELBS Edition)
- 2) Vogel's Text Book of Qualitative Chemical Analysis (Longman ELBS Edition)
- 3) Basic Concepts in Analytical Chemistry (Wiley Eastern Ltd.) : S. M. Khopkar.

C) Organic Chemistry

1) Estimations : (any two)

- i) Estimation of aniline, ii) Estimation of acetamide and iii) Estimation of Aspirin

2) Organic Qualitative Analysis.

Identification of at least five organic compounds with reactions including one from acids, one from phenols, one from bases and two from neutrals from the list of the compounds given below-

- i) Acids : Oxalic acid, Benzoic acid and Cinnamic acid
ii) Phenols : β - Naphthol, Resorcinol.
iii) Bases : Aniline, p - Toluidine.
iv) Neutrals : Acetone, Ethyl acetate, Glucose, Chloroform, Chlorobenzene, m-dinitrobenzene, Thiourea.

Note : A systematic study of an organic compound involves the following operations which should be taught in details with reactions in the detection of elements and functional group.

- 1) Preliminary tests and physical examination.
- 2) Determination of physical constant.
- 3) Detection of Elements.
- 4) Determination of functional group.
- 5) A search into the literature.
- 6) Special Test.
- 7) Summary.
- 8) Result.

3) Organic Preparation: (Any one)

- i) Preparation of benzoic acid from benzamide.
ii) Preparation of dibenzal acetone from benzaldehyde and acetone.

(Wt. of crude product is expected. M.P. of the recrystallized product is not expected.)

Reference Books:

- 1) Vogel's Text Book of Quantitative Chemical Analysis, (Longman) ELBS. Edition
- 2) Vogel's Text Book of Qualitative Chemical Analysis, (Longman) ELBS. Edition
- 3) Hand book of Organic Qualitative Analysis : Clarke
- 4) Comprehensive Practical Organic Chemistry - Quantitative Analysis by V.K. Ahluwalia, Sunita Dhingra, University Press. Distributor - Orient Longman Ltd.,
- 5) Comprehensive Practical Organic Chemistry preparation and Quantitative Analysis. : V.K. Ahluwalia, Renu Agarwal, University Press. Distributor - Orient Longman Ltd.,
- 6) A laboratory Hand-Book of organic Qualitative Analysis and separation :V. S. Kulkarni, Dastane Ramchandra and Co. Pune

Solapur University, Solapur
Nature of Question Paper for choice based credit system (CBCS) Semester Pattern
• Faculty of Science •
(w. e. f. June 2016)

Time: - 2.30 hrs.

Total Marks- 70

Instructions:

1. All questions are compulsory.
2. Draw **neat diagrams** and give **equations** wherever necessary.
3. Figures to the **right** indicate **full marks**.
4. Use of logarithmic table and calculator is allowed.

(At. Wts.: H=1, C=12, O=16, N= 14, Na =23, Cl = 35.5)

Q. No.1) Multiple choice questions

(14)

- 1) -----
a) b) c) d)
- 2)
3)
4)
5)
6)
7)
8)
9)
10)
11)
12)
13)
14)

Q.No.2) Answer any Seven of the following

(14)

- i)
ii)
iii)
iv)
v)
vi)
vii)
viii)
ix)

Q.No.3 A) Write notes on any Two of the following

(10)

- i)
ii)
iii)

B) Solve / short answer

(04)

Q. No.4) Answer any Two of the following

(14)

- i)
ii)
iii)

Q.No.5) Answer any Two of the following

(14)

- i)
ii)
iii)