

North Maharashtra University, Jalgaon
Revised syllabus for F.Y.B.Sc. Chemistry

From July 1997

Course structure :- there will be two theory Papers of 100 marks each and one practical course of 100 marks. Each theory course should be covered in three periods per week. The practical course will require four periods per week per batch. There should not be more than 15 students in a batch. The title of the papers are as under :-

- i) Paper-I : Physical and Inorganic Chemistry
- ii) Paper-II : Organic and Inorganic Chemistry
- iii) Chemistry Practical-I

PAPER-I : PHYSICAL AND INORGANIC CHEMISTRY

1. ATOMIC STRUCTURE :-

Rutherford's alpha particle scattering experiment, Rutherford's atomic model and its drawbacks, Moseley's work and its importance (numerical problems are not expected), quantum theory of radiation, line spectra of atoms, Balmer's formula, Ritz combination principle.

Bohr's atomic model, derivation of the expressions for radius of orbit energy of an electron in its orbit, origin of spectral series in atomic hydrogen, failure of Bohr's atomic model, ionization potentials, quantum numbers.

Ref.1, Chapter 14, Pages 608 to 622

Ref.2, Chapter 1, Pages 7 to 17, 21 to 28

(10)

2. THE GASEOUS STATE :-

The gas constant R and its values in different units, kinetic theory of ideal gases, deductions from kinetic theory of gases such as Boyle's law, Charles's law, Avogadro's law, Graham's law, Dalton's law, velocity of gas molecules, kinetic energy of translation, distribution of molecular velocities, frequency of collisions and mean free path.

Applicability of the ideal gas laws, compressibility factor the van der Waal's equation of state, critical phenomena in liquids, P-V-T relations of gases and liquids, the principle of continuity of states, application of van der Waal's equation to the isothermals of carbon dioxide, determination of van der Waal's constants, determination of critical volume of a gas, the principle of corresponding states.

Ref.1, Chapter 1, Pages 10 to 12, 15 to 32, 47 to 55

Ref.2, Chapter 10, pages 261, 264 to 278, 281 to 294.

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3. LIQUID STATE :-

Intermolecular forces in liquids, dipole-dipole attractions, London forces, hydrogen bonding, surface tension and its determination by capillary rise method and drop formation method, viscosity, units of viscosity, measurement of viscosity by Oswald method.

Ref.2, Chapter 11, Pages 301 to 303, 306 to 310, 312 to 315

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4. DISTRIBUTION LAW :-

Statement and explanation of Nernst distribution law (Thermodynamic derivation is not expected), applicability and limitations of distribution law, modification of distribution law with reference to association and dissociation of solute, applications of distribution law and theory of extraction.

Ref.1, Chapter 8, Pages 293 to 302

Ref.2, Chapter 18, Pages 437 to 492, 496 to 501, 503 to 505

(6)

5. ELECTRICAL CONDUCTANCE :-

Transference and transference numbers, Hittorf's rule determination of transference number by Hittorf's method using unattackable electrodes.

Electrolytic conductance, determination of conductance, variation of conductance with concentration equivalent conductance at infinite dilution, Kohlrausch's law and its applications, applications soluble of conductance measurements : (a) determination of solubility of difficult salts. (b) determination of degree of ionization (c) conductometric titrations and their advantages.

Ref.1, Chapter 11, Pages 405 to 411, 414 to 423, 431 to 434

Ref.2, Chapter 24, Pages 638 to 640, 642 to 644, 650 to 655

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6. EXPRESSION OF ANALYTICAL RESULTS :

Solid samples and liquid samples.

Ref.3, Pages 17 to 23

(2)

7. PRINCIPLES OF VOLUMETRIC ANALYSIS :

General principles, titration, standard solution, classification of volumetric methods, moles, molarity, molarity calculations, general calculations with molarity, dilution calculations, variable reactions in molarity calculations, back titrations.

Normality, formality, molality, density calculations, normality calculations, equivalent weight, reacting units in normality calculations, acid-base, reduction-oxidation, precipitation and complexometric, summary of normality calculations, titre.

Ref.3, Pages 8 to 15, 137 to 158.

(The solution of numerical problems on Chapter No.6 to 7 is expected.)

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8. BONDING IN MOLECULES AND THEIR STRUCTURES :

- A) i) Attainment of stable configuration.
ii) Types of bonds
iii) Transition between the main types of bonding: ionic, covalent, coordinate bonds, double and triple bonds, metallic bonds and metallic structures, general properties of ionically and covalently bonded compounds.

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Ref. 5, Page 14 to 32.

- B) i) Concept of hybridization.
 ii) Hybridization in the following molecules : PCl_5 , ClF_3 , SF_4 , IF_3 , SF_6 , IF_7 .
 iii) The extent of d-orbital participation in molecular bonding, sigma and pi bonds in CO_2 , SO_2 and SO_3 molecules.
 Ref. 5, Pages 49 to 50, 54 to 51.

(4)

C) Molecular Shapes :

The valence shell electron pair repulsion (VSEPR) model, the hybridization or directed valence theory, a three centre bond model.

Ref.4, Pages 83 to 86

(4)

REFERENCES

- 1) Principles of Physical Chemistry (Oxford and IBH Publishing Co. Pvt. Ltd.) (4th edition) by S.H. Maron and C.F. Prutton
- 2) Essentials of Physical Chemistry (S. Chand and Co. Ltd.) (23rd edition) by B.S. Bahl, G.D. Tuli and A. Bahl.
- 3) Analytical Chemistry (John Wiley and Sons Inc) (3rd edition) by G.D. Christian
- 4) Basic Inorganic Chemistry (1st edition) by Cotton and Wilkinson
- 5) A New Concise Inorganic Chemistry (3rd edition) by J.D. Lee.
- 6) A Text Book of Chemistry (for North Maharashtra University, Jalgaon) Vidya Books Publishers.

PAPER-II : ORGANIC AND INORGANIC CHEMISTRY

1. STRUCTURE AND PROPERTIES OF ORGANIC COMPOUNDS :

- i) Definition of organic chemistry, brief historical perspective of organic chemistry (ref 2,1.1)
- ii) covalent bond, hybridization in ethane, ethene and ethyne molecules (ref. 1: 1.8, 1.9, 1.10, 1.11, Ref. 2: 3.3)
- iii) Bond length, bond energy, bond angle, bond polarity of molecules.
 (Ref 1, 1.15, 1.16)
 (Ref. 2, 3.4, 3.5)
- iv) Qualitative detection of elements (Ref. 7,9.3 Pages 1205-1208)
- v) Empirical formula and molecular formula (Ref. 1,2.28, 2.29)
 [Simple numerical problems are expected]

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2. NOMENCLATURE OF ORGANIC COMPOUNDS:

- i) Classification of organic compounds based on functional groups.
- ii) Nomenclature of organic compounds : Trivial and IUPAC systems. Nomenclature of alkanes, alkynes, alkyl halides, alcohols, aldehydes, ketones, ethers, acids and their derivatives, amines, nomenclature of benzene derivatives.

Ref. 1, 13.11

Ref. 2, 2.1, 2.2

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3. HYDROCARBONS

- i) Alkanes : Synthetic methods and reactions of alkanes.
Ref. 1, 3.15, 3.19, 3.30, 3.31.
- ii) Alkenes :
Synthetic methods.
Reactions of alkenes : catalytic hydrogenation, addition of halogens, HX, H2SO4, and HOX, oxymercuration and demercuration, ozonolysis.
Ref. 1, 7.11, 8.2
- iii) Alkynes :
Synthetic methods.
Reactions of alkynes : addition of hydrogen, Na/NH3, use of Lindler catalyst, formation of metal acetylides, addition of water.
Ref. 1, 11.6, 11.7

4. ALKYL HALIDES:

- Synthetic methods :
- i) Addition of HX to alkenes
- ii) From alcohols.
Reactions of alkyl halides : Formation of alcohol, ether, alkene, nitrile, ester, amine, thiol and Grignard's reagent.
Ref. 1, 8.5, 8.6, 5.7, 5.8

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5. ALCOHOLS:

- Synthetic methods :
- i) Reduction of acid chloride
- ii) From Grignard's reagent
- iii) Hydroboration of alkene.
Reactions of alcohols : Reaction with active metals, dehydration, ester formation, oxidation.
Ref. 1, 17.8, 21.9, 18.2.

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6. ALDEHYDES AND KETONES:

- Synthetic methods :
- i) Reduction of acid chloride
- ii) From Grignard's reagent.
Reactions of aldehydes and ketones : Oxidation, reduction (Clemmenson and W.K.), addition of HCN, NaHSO3, and derivatives of ammonia, aldol condensation, Cannizzaro's reaction.
Ref. 1, 21.4, 21.5, 21.8, 21.9, 21.12, 21.14.

(5)

7. ACIDS:

- Synthetic methods :
- i) Carbonation of Grignard's reagent
- ii) Hydrolysis of nitride.
Reactions of acids : Acidity as salt formation, conversion into acid chloride, ester, aside and anhydride.
Ref. 1, 23.6, 23.9.

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8. AMINES:

- Synthetic methods :
- Reduction of nitrocompounds, nitriles, reductive lamination, Hoffmann degradation of amide.
- Reactions of amines : Basicity as salt formation, alkylation, reaction with nitrous acid, acetylation.
Ref. 1, 26.8, 27.1

(3)

9. **STRUCTURE AND REACTIVITY:**
 Inductive effect, resonance, hyperconjugation, tautomerism,
 structure of benzene and its aromaticity.
 Ref. 3, 5.1.1, 1.5.4, 1.3.6, 1.3.7, 10.4.7 (6)
10. **ELECTRONIC CONFIGURATION OF ELEMENTS:**
 i) Aufbau principle,
 ii) Hund's rule of maximum multiplicity.
 iii) Shapes of s, p, d orbiters.
 Ref.4, Chapter 1, relevant pages
 Ref.5, Pages 23 to 31, 71 to 80
 Ref.6, Chapter 2, relevant pages
 Ref.8, Pages 301 to 305, 319 to 324 (3)
11. **LONG FORM OF THE PERIODIC TABLE AND PERIODIC PROPERTIES:**
 i) Outline of the long form of the periodic table.
 ii) Classification of elements in terms of s, p, d and f block
 elements, inert gas elements, representatives elements,
 transition elements, inner transition elements.
 iii) Periodic law, periodicity in the following properties
 throughout the periodic table (General trends in each block
 are expected. Trends in any particular group or period are
 not expected) :
 a) Size of atoms and ions
 b) Ionization energy
 c) Electron affinity
 d) Electronegativity
 e) Metallic character.
 Ref.4, Pages 20 to 22, 92 to 103
 Ref.5, Pages 25 to 31
 Ref.6, Pages 43 to 46 (9)
12. **CHEMISTRY OF HYDROGEN:**
 Position in the periodic table, isotopes of hydrogen, ortho and
 para hydrogen, properties of molecular hydrogen, hydrides.
 Ref.4 pages 117 to 123. (5)
13. **S-BLOCK ELEMENTS:**
 i) Alkali metals: Electronic structure, general properties, chemical
 properties, volatility and hydration, solutions of metals in
 liquid ammonia, stability of oxysalts, halides, extraction of
 metals, difference between lithium and other group-I elements.
 ii) Alkaline earth metals: Electronic structure, general properties,
 anomalous behaviour of beryllium, solubility and lattice energy,
 chemical properties, extraction of metals, difference between
 beryllium and other group-II elements.
 Ref. 4, Pages 128 to 136 to 140, 150 to 151. (7)
- REFERENCES:**
1. Organic Chemistry
 by Morrison and Boyd (5th edition)
 2. organic Chemistry
 by Pine, Hendrickson, Cram and Hammand (4th edition)
 3. A GUIDE BOOK OF Reaction Mechanism
 by Peter Sykes
 4. A New Consise Inorganic Chemistry
 by. J.D. Lee (3rd edition)
 5. A New Guide to Modern Valency theory
 by G.I. Brown (3rd edition)
 6. Basic Inorganic Chemistry
 by Cotton and Wilkinson (1st edition)

7. Vogel's Text Books Practical Organic Chemistry (5th edition)
8. Advanced Inorganic Chemistry by Satya-Prakash-Tuli.
9. A Text Book of Chemistry (for North Maharashtra University, Jalgaon) Vidya Books Publishers

CHEMISTRY PRACTICAL : I

A) PHYSICAL CHEMISTRY:

(Any five of the following experiments)

1. Determination of water equivalent of thermos flask, heat of neutralization and ionization of a weak acid.
2. Determination of water equivalent of theorems flask and heat of solution of $\text{HNO}_3/\text{NH}_4\text{Cl}$.
3. Determination of surface tension of any two of the following liquids by drop number method using stalagmometer : Toluene, Aniline, Ethano, n-propanol, n-butanol.
4. Determination of relative viscosity of any two of the following liquids using Ostwald viscometer : Acetone, Toluene, Ethyl acetate, Ethanol, n-propanol, n-butanol.
5. Determination of partition coefficient of iodine between water and carbon tetrachloride.
6. Determination of cell constant and dissociation constant of acetic acid by conductometric method.
7. Conductometric titration of NaOH and HCl .

B) INORGANIC CHEMISTRY:

1. Qualitative analysis:
Qualitative analysis of solid compound containing one cation and one anion (excluding phosphate and borate).
Minimum 10 compounds are to be analyzed by each student.
2. Gravimetric analysis:
Determination of loss per gram and hence percentage purity of zinc carbonate.
3. Volumetric analysis:
 - i) Standardization of the given KMnO_4 solution by the given standard oxalic acid solution and estimation of Fe(II)
 - ii) Standardization of the given $\text{Na}_2\text{S}_2\text{O}_3$ solution by the given standard $\text{K}_2\text{Cr}_2\text{O}_7$ solution and estimation of copper iodometrically.
 - iii) Standardization of the give EDTA solution by the given standard zinc sulphate solution and estimation of total hardness of water.

C) ORGANIC CHEMISTRY:

- i) Organic estimation - estimation of (a) acetone aniline/phenol.
- ii) Organic qualitative analysis.
Determination of i) preliminary tests ii) physical constant (m.p./b.p.) iii) type iv) functional group of single organic compound.
Minimum 8 of the following compounds are to be analyzed by a student:

- i) Acids : benoic, acetic, salicylis, oxalic acids
 ii) Phenols : alpha and beta naphthols.
 iii) Bases : aniline, p-toluidine, p-nitroaniline
 iv) Neutrals : ethanol, n-propanol, methyl acetate, ethyl acetate, ethyl benzamide, acetone, benzaldehyde, benzophenone, acetophenone, nitrobenzene, benzedrine, acetamide, urea.

3. Purification of Organic Compound:
 Purification of water soluble organic compound by crystallization and determination of melting point, (only two compounds are to be purified by each student).

REFERENCES:

1. Advanced Practical Physical Chemistry by J.B. Yadav (Goel Publishing House Meerut)
2. Findlay's Practical Physical Chemistry Revised by B.P. Levitt and J.A. Kirthner Longman Group Ltd.
3. Systematic Experimental Physical Chemistry By Rajbhoj and Chondhekar (Anjali Publication Aurangabad)
4. Vogel's Text Book of Practical Organic Chemistry (5th Edition)
5. Vogel's Text Book of Quantitative Chemical Analysis.
6. A Text Book of Practical Chemistry (for North Maharashtra University, Jalgaon) Vidya Books Publishers.

EXAMINATION STRUCTURE

1. Paper-I : Physical and Inorganic Chemistry

There will be six questions. Four questions will carry 16 marks each and two questions 18 marks each. The question paper should include 20 to 24 % weightage for problem solving. The distribution of questions and marks for Physical and Inorganic Chemistry topics will be as under :

- i) Physical Chemistry (Chapters 1 to 5) : Three questions of 16 marks each and one question of 18 marks.
- ii) Inorganic Chemistry (Chapters 6 to 8) : One question of 18 marks and one question of 16 marks.

Topicwise division of marks: (Variation of $\pm 5\%$)

Chapter No.	Title	Marks out of 100	Total marks with internal options
1.	Atomikc Structure	14	21
2.	The Gaseous State	20	30
3.	Liquid State	10	15
4.	Distribution law	08	12
5.	Electric Conductance	14	21
6.	Expression of Analytical Results	02	03
7.	Principles of Volumetric Analysis	14	21
8.	Bonding in Molecules and their Structures	18	27
Total		100	150

2. Paper-II : Organic and Inorganic Chemistry

There will be six questions. Four questions will carry 16 marks each and two questions 18 marks each. The distribution of questions and marks for Organic and Inorganic Chemistry topics will be as under :

- i) Organic Chemistry (Chapters 1 to 9) : Three questions of 16 marks each and one question of 18 marks.
- ii) Inorganic Chemistry (Chapters 10 to 13) : One question of 18 marks and one question of 15 marks.

Topicwise division of marks: (Variation of $\pm 5\%$)

Chapter No.	Title	Marks out of 100	Total marks with internal options
1.	Structure and Properties of Organic Compounds	14	21
2.	Nomenclature of Organic Compounds	12	18
3.	Hydrocarbons	08	12
4.	Alkyl Halides	05	08
5.	Alcohols	04	06
6.	Aldehydes & Ketones	07	10
7.	Acids	04	06
8.	Amines	04	06
9.	Structure & Reactivity	08	12
10.	Electronics Configuration of Element	04	06
11.	Long form of Periodic Table and Periodic Properties	13	20
12.	Chemistry of Hydrogen	07	10
13.	S-Block Elements	10	15
Total		100	150

3. Scheme for Practical Examination:

The examination will be of 6 hours duration. It will be conducted as follows:

- | | | |
|----|---|----------|
| A) | Physical Chemistry Experiment | 35 Marks |
| B) | Any one of the following | 30 Marks |
| | i) Inorganic Volumetric Analysis | |
| | ii) Inorganic Gravimetric Analysis | |
| | iii) Organic estimation | |
| C) | i) Inorganic Qualitative Analysis | 25 Marks |
| | OR | |
| | ii) a) Organic Qualitative Analysis | 15 Marks |
| | b) Purification of Organic compound by Crystallization. | 10 Marks |
| D) | Journal | 10 Marks |
- Important Note : Book/Typed/Cyclostyled/Printed material will be allowed during the examination.

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