

NORTH MAHARASHTRA UNIVERSITY,  
JALGAON - 425 001.

Skeleton of Papers at S.Y.B.Sc Passed in BOS in Chemistry.

Paper III                      Physical and Analytical Chemistry.

Section I (Physical Chemistry)

Part A (First term)

1. Second and third laws of thermodynamics	(12)
2. Free energy and equilibrium	(12)
Total	24

Part B (Second term)

1. Colligative properties of Solutions	(10)
2. Equilibrium electrochemistry	(7)
3. Chemical equilibrium	(4)
4. Colloids	(3)
Total	24

Section II (Analytical Chemistry)

Part A (First term)

1. Acid-base titrations	(5)
2. Redox titrations	(4)
3. Precipitation titrations	(3)
4. Complexometric titrations	(4)
5. Fundamental theoretical principles	(6)
6. Sampling	(2)
Total	24

Part B (Second term)

1. Theory of Qualitative Analysis	(8)
2. Experimental technique of Qualitative organic analysis	(3)
3. Detection and Estimation of C,N,O and halogens	(6)
4. Errors in quantitative analysis	(4)
5. Air Pollution	(3)
Total	24

Paper IV                      Organic and Inorganic Chemistry

Section I (Organic Chemistry)

Part A (First term)

1. Stereoisomerism	(10)
2. Chemistry of polycyclic compounds	( 8)
3. Study of Synthetic reagents	( 6)
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Total	24

Part B (Second term)

1. Carbohydrates	(8)
2. Proteins	(8)
3. Reaction mechanism	(8)
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Total	24

Section II (Inorganic Chemistry)

Part A (First term)

1. Molecular Orbital theory	(5)
2. Principles of metallurgy	(4)
3. Inorganic reactions in aqueous Solutions	(4)
4. Non-aqueous Solvents	(3)
5. Chemistry of gr. III, IV and V	(8)
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Total	24

Part B (Second term)

1) Chemistry of VI, VII and Zero groups	(10)
2) Ionic solids	(10)
3) Classification of simple molecules into their point groups.	( 4)
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Total	24
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S.Y.B.Sc. Chemistry Paper III Section I Physical Chemistry.

(From June, 1993)

Part A (First Term)

Chapter I : Second and Third laws of Thermodynamics :

- 1) Recapitulation :- Draw backs of First law of thermodynamics, Reversibility & max. work, enthalpy, heat capacity, Isothermal Process.
- 2) Adiabatic process in ideal gases,  $PV^\gamma = \text{constant}$  & expression for maximum work in adiabatic process, Carnot's cycle, Thermodynamic efficiency.
- 3) Spontaneous and non-spontaneous processes, Second law of thermodynamics, entropy, entropy change in isolated systems, entropy change for systems only, entropy change for ideal gases, entropy of mixing for ideal gases, entropy change in physical transformations, entropy change in chemical reactions, second law in terms of entropy.
- 4) Third law of thermodynamics and evaluation of absolute entropy. (12)

Ref. 1 pages 107 to 113, 116 to 120, 123 to 128,  
162 to 170, 174 to 183.

Chapter II : Free energy and equilibrium :

Helmholtz free energy,  $\Delta A$  for reactions, Gibbs free energy,  $\Delta F$  for reactions, properties and significance of  $\Delta F$ , calculations of free energy changes, fugacity and activity concepts, standard state for gases, determination of activity coefficients of gases, reaction isotherm, Standard free energy of formation, criteria of equilibrium, Physical equilibria involving pure substances, use of clapeyron equation, variation of vapour pressure with temperature. (12)

Ref. 1 Pages 189 to 212, 215 to 219.

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S.Y.B.Sc. Chemistry Syllabus

Physical Chemistry Paper III Section I

Part B (Second Term)

Chapter I : Collegative properties of Solutions :

Solutions of non-electrolytes, lowering of vapour pressure of solvents, elevation in boiling point of solutions, calculation of molecular weight from elevation of boiling point, lowering of freezing point of solutions, Osmosis and osmotic pressure, relation of osmotic pressure to vapour pressure, van't Hoff's equation for osmotic pressure, Landbergers and Beckmann methods, solutions of electrolyte and their Collegative properties, Arrhenius theory of electrolytic dissociation, classification of electrolytes, criticism of the Arrhenius theory. (10)

Ref. 1 Pages 312 to 336

Ref. 4 Pages 455 to 456, 462 to 463

Chapter II : Equilibrium electrochemistry :

(Electrochemical cells) Electrochemical cells, standard electrode potentials, Thermodynamic data from cell e.m.f.s., simple applications of e.m.f. measurements.

Ref. 2 Pages 259 to 282

( 7)

Chapter III : Chemical equilibrium :- Thermodynamic equilibrium constant,  $K_p$ ,  $K_c$  for gaseous reactions, relation between  $K_p$  &  $K_c$ , properties of equilibrium constant, the Le chaterlier - Braun principle, ammonia and phosgene equilibria, effect of inert gases on equilibrium, Variation of  $K_c$  and  $K_p$  with temperature.

Ref. :- 1 Pages 228 to 238, 242 to 243, 248 to 251

Ref. :- 4 Pages 507 to 512

(4)

Chapter IV : Colloids :- classification, Preparation and purification, Surface, Structure and stability, the electric double layer. Ref. 2 Pages 628 to 632

References:

- 1) Principles of Physical Chemistry (4th edition) Prutton and Maron.
- 2) Physical Chemistry by - P.W. Atkins (Third Ed<sup>n</sup>).
- 3) Elements of Physical chemistry by S.Glasstone and D.Lewis.
- 4) Essentials of Physical chemistry by Bahl and Tuli.

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S.Y.B.Sc. Paper III Section-II.

Analytical Chemistry

Part A (First Term) Syllabus.

1. Acid Base titrations : (5)

Neutralisation, Indicators, preparation of Indicator solution, Mixed and Universal indicator, Neutralisation Curves of Strong acid-strong base, weak acid-strong base, strong acid-Weak base, and weak acid-weak base, choice of Indicators in neutralisation Reactions.

Ref. : 1 Page No. 236 - 251, 255 - 256.

2. Redox Titrations : (4)

Electrode potentials, concentration cell, oxidation-Reduction cell, calculation of standard ~~reduction~~ <sup>electrodes</sup> potential, oxidation-Reduction curve, formal potential, Detection of end point in oxidation - Reduction titrations.

Ref. : 1 Page No. 46-53, 288-296.

3. Precipitation Titrations : (3)

Preparation of standard silver nitrate solution, standardisation of silver nitrate; Determination of chloride by Mohr method.

Ref. 1 Page No. 281-286, 336-339.

4. Complexometric Titrations : (4)

General discussion, Titration curves, Types of EDTA titrations.

Ref. 1 Page- 261-264, 265-267.

5. Fundamental theoretical principles : (6)

Electrolytic dissociation, Law of mass action, acid-base equilibria in water, Determination of ionisation constant, strengths of acids & bases, Ionisation of Polybasic acids, Common ion effect, solubility product, Buffer solutions.

Ref. 1 14-23, 33-36, 42-46.

6. Sampling : (2)

Basis of sampling, sampling and physical state, Crushing and grinding. Ref. 1 Page No. 135 - 138

Reference : 1. Text book of Quantitative Inorganic Analysis by Vogel 4th Ed<sup>n</sup>.

S.Y.B.Sc. Paper-III Section-IIAnalytical ChemistryPart B - (Second Term) Syllabus : (8)1. Theory of Qualitative Analysis :

(Test of Individual cation not expected)

General scheme for the separation of cations in ~~two~~<sup>to</sup> groups, Uses of different precipitants of different groups, separation of cation in individual groups & subgroups, phosphate and Borate removal scheme, Use of HCL, H<sub>2</sub>S, NH<sub>4</sub>CL, NH<sub>4</sub>OH as buffer to maintain the PH. Use of solubility product and common ion effect in qualitative analysis, Use of NaOH & Yellow ammonium sulphide in separation of Group II.

Ref. 2 Page 503-534, 568-570

2. Experimental Technique of Quantitative Organic Analysis : (3)

Methods of purification - Brief review of crystallisation fractional crystallisation & different types of distillation.

Ref. 3 Page 105-111, 141-150.

3. Detection and estimation of elements C, H, N, O & halogens

Ref. 3 Relevant pages. (6)

4. Errors in quantitative analysis :- Accuracy, precision, Mean deviation, standard deviation, Classification of errors, Minimisation of errors, Determination of accuracy of methods significant figures.

Ref. 1 Page 121-127. (4)

5. Air Pollution with reference to the following:

Automobile emission, ~~Smog~~<sup>Smoke</sup>, CO & CO<sub>2</sub>

Ref. 4 (3)

Reference Books :

1. Text Book of Quantitative Inorganic Analysis  
By - A.J. Vogel 4th Edn.
2. Text Book of Macro and Semi-Micro Qualitative Analysis :  
By - A.J. Vogel 4th Ed.
3. Qualitative Organic Analysis By Vogel.
4. Environmental Chemistry - By A.K. Deo.

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S. Y. B.Sc. Paper IV.

Organic and Inorganic Chemistry.  
 Section - I (Organic Chemistry)  
PART - A (First Term)

- 1) Stereoisomerism : (10 Lectures)
- (a) Geometrical,  $\text{>C} = \text{C} \begin{matrix} \diagup \\ \diagdown \end{matrix} \begin{matrix} \text{OH} \\ \text{N} \end{matrix}$  (oxime), -N=N-  
 (Azobenzene) Methods of determination of E and Z configurations.
- (b) Optical isomerism, introduction, elements of symmetry, R and S configurations for compounds containing one assymmetric carbon only.
- (c) Conformational isomerism,  
 Ethane, propane, n-butane, Cyclonexane, monosubstituted cyclonexane (excluding Baeyer strain theory)
- Ref.1- 4,1,4,3,4,7,4.8, 4.9, 4.10, 4.14, 4.15, 4,16, 4.20,  
 7.6,3.3,3.4,3.5,12.10,12.11,12.12,  
 Ref.2- 6.2, 6.4  
 Ref.3- 12.1
- 2) Chemistry of polycyclic compounds (Lectures 8)
- (a) Structure determination, synthesis and reactions of  
 - Napthalene.  
 Ref. I, 34.2, 34.3, 34.4.
- (b) Chemistry of heterocyclic compounds:-  
 Five membered heterocyclic compounds, -Furan, Thiophene,\*  
 Pyrrole and Six membered heterocyclic- Pyridine (Synthesis  
 and reactions only).  
 Ref-4. Pages 828, 830-832, 834, 835-837.  
 and relevent pages of Ref-I.
- \* Synthesis of pyrrole from Acetylene, furan, succinamide,  
 1,4 diketone.

- 3) Study of synthetic reagents. (Lectures 6)  
Malonic ester, Aceto acetic ester, Grignard Reagent.  
Ref-1 Pages 1059-67  
Ref-4 424-433.

Part B (Second term) (8)

1) Carbohydrate - definition, classification, fischer projection formula, Kiliani's synthesis, structure and reactions of Glucose, Pyranos structure, and conformations, mutarotation, structure determination of Fructose - reactions and conformations.

Ref-5 Chapter 2-pages 25, 27, 29, 31, 34, 35, 42, 47, and 49.

2) Proteins (a) Definition and classification, (8)  
Zimmitterion concept, peptide synthesis, N-terminal and C. terminal analysis of proteins and structure of protein  
Ref- 5 Relevent pages.

(b) Synthesis and uses of agrochemicals.

- 1) Lindane 2) D.D.T. 3) 4-Naethyl acetic acid
- 4) Endosulfan 5) 2-4 D 6) Indole acetic acid
- 7) Parathion.

Ref -7. Relevent pages.

3) Reaction mechanism:-

a) Meaning, fission of covalent bond, types of reagent and types of reactions - addition, elimination, substitution with general mechanism.

b) Electrophilic aromatic substitution reactions- Nitration, Sulphonation, Halogenation. with mechanism.

Ref - 6 Pages 20, 28, 29, 30, 31, 32, 132, 133, 137, 138, 139,

Ref 1) Organic chemistry by Morrison and Boyd - 6th Ed<sup>n</sup>.

2) Organic chemistry by, - Stanley Pine-5th Ed<sup>n</sup>.

3) Stereochemistry of carbon compound's by Elieff.

4) Organic chemistry by Finar vol<sup>m</sup> - I 6th Ed<sup>n</sup>.

5) Outline of Biochemistry by Conn and Stumpf.

6) Guide book to mechanism in Organic Chemistry by Syke 5th Ed<sup>n</sup>.

7) Organic chemistry by Finar Vol<sup>2</sup> - 6th Ed<sup>n</sup>.



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Inorganic - Chemistry.

S. Y. B.Sc. Paper IV.

Section II

Part A (Ist Term).

1) Molecular orbital theory-

L C A O Method, S-P, P-P, P-d, d-d- combination of orbitals, Non-bonding combination of Orbital, Rules for L C A O. Examples of molecular orbital treatment  $H_2$  to  $Ne_2$  (Homonuclear diatomic molecules) (5)

1) Concise Inorganic chemistry by

Ref- J-D Lee, Third Edition, Pages 61 to 73.

2) Principles of Metallurgy

Occurance of metal, Types of ores, Process in metallurgy crushing, concentration of ore such as hand picking, gravity separation, leaching, magnetic separation, froth floatation process, calcination, roasting, reduction process, smelting, types of flux, slag, Alumino thermic process. (4)

Ref - Advance inorganic chemistry by Satyprakash Tuli Basu Pages- Relevent Pages.

3) In-organic reactions in aqueous solutions :- Problem of solubility, Effect of temp on solubility, roll of water as a solvent, chemical structure and solubility, solubility resulting from chemical reaction. (4)

Ref - Fundamental concept of Inorganic chemistry By- Esmarch and Gilreath. (268-278)

4) Non-aqueous. Solvent :- (2) Liquid - Ammonia (3) and (3) Liq HF (1) Classification of solvents (316-326)

Ref : Fundamental concept of In-Organic Chemistry. By - Esmarch S. Gilreath.

5) Chemistry of following :-

Group III, IV, and V. elements.

With reference to position of elements in periodic table, electronic configuration, General properties and trends in the group.

Bonding and shapes of following molecules:-

$B_2O_3$ ,  $Al_2Br_6$ , Co,  $Co_2$ , diamond, Graphite,  $N_2O_5$ ,  $P_4O_{10}$ ,

$P_4O_6$ ,  $H_3PO_4$ ,  $P_4$ .

By J.D. Lee

Reference : Concise Inorganic Chemistry, 3rd Ed<sup>n</sup> Pages- 154 to 228.

Note : Only above mentioned point should be covered.

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S. Y. B.Sc.

Inorganic Chemistry; Paper IV (Section III)

Part - B (IInd Term)

1. Chemistry of following groups :-

VI, VII and Zero.

With reference to general properties, position in periodic table, Electronic configuration, General trends in the group.

Bonding and shapes of following molecules.

Ozone,  $H_2O_2$ ,  $S_8$ ,  $SF_4$ ,  $SO_2$ ,  $SO_3$ ,  $H_2SO_4$ ,  $ClO_2$ ,  $Cl_2O_7$ ,  $ClF_3$ ,

$BrF_3$ ,  $IF_7$ ,  $Icl_2^-$ ,  $I_3^-$ ,  $XeF_2$ ,  $XeF_4$ ,  $XeF_6$ ,  $XeO_3$ ,  $XeOF_4$ ;

Ref : J.D. Lee (Concise Inorganic chemistry)

Page 229-286.

Note- Only above mentioned points should be covered from relevant pages.

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2. Ionic solids- Difference between amorphous and crystalline

solid, Types of Crystal structure, Simple cubic, FCC, BCC,

Types of holes, Polarisation of ions, Fajan's rule, Ionic

radii Pauling univalent and Crystal radii, Radius ratio

effect, Lattice energy, Born Haber Cycle and its applications,

General characteristics of Ionic solids, Schottky and

Frenkel defect. Solubility of ionic solids Semiconductors and

transistors.

(10)

Ref. Concise In-organic chemistry by

J-D. Lee. Page 32-38, 41-46.

Ref. G.J. Brown.

Pages 55 - 62.

3. Classification of simple molecules into their point groups

such as :-  $CO_2$ ,  $HCl$ ,  $N_2H_2O$ ,  $NH_3$ ,  $BCl_3$ ,  $C_6H_6$ ,  $PCl_5$ ,

ethylene, trans dichloro ethylene.

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Ref : Applications of Group theory

F - A Cotton (Relevant Pages).

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S.Y.B.Sc. (Practicals) from June 1993.

Physical Chemistry : (Any Six)

1. To determine the molecular weight of a given non-volatile substance by Landsberger's method.
2. To determine the molecular weight of a substance by freezing point depression of naphthalene.
3. To determine  $\Delta H$ ,  $\Delta F$  and  $\Delta S$  for the reaction,  
$$\text{Cu (s)} + 2 \text{Ag}^+ \rightleftharpoons \text{Cu}^{++} + 2 \text{Ag}.$$
4. To determine the degree of dissociation of a given non-volatile electrolyte. (conductometrically)
5. Conductometric titration of strong acid/weak acid and strong base.
6. Determination of heat of precipitation of AgCl & Ag Br.
7. Determination of heat of solution of sulfuric acid and determine the strength of an unknown sample of sulfuric acid.
8. Determine the dimerisation constant of salicylic acid in benzene at  $35^\circ$ ,  $40^\circ$ ,  $45^\circ$   $50^\circ$  and find out the enthalpy change.
9. To determine the viscosity of liquid A & B and their mixtures & Hence to determine the composition of unknown mixture.

References :

1. Practical physical Chemistry  
C.N.R. Rao
2. Experimental physical Chemistry : Das and Behera  
(Tata McGraw Hill).
3. Practical Physical Chemistry : Yadav.

- Inorganic Practicals -

1. Inorganic qualitative Analysis (at least six mixtures)  
(Excluding phosphates & borates)  
(Two acidic + Two basic radicals).
2. Preparations (Any two)
  - 1) Ferrous ammonium sulphate
  - 2) Preparation of sodium thiosulphate
  - 3) Preparation of Tetramino Cu (II) Sulphate

- Analytical (Any Four) -

1. Estimation of aspirin (APC Tablets)
2. Estimation of Lead (pb (II) as lead chromate (By counterpoise method)
3. Estimation of Ni as NiDMG (By counterpoise method)
4. Estimation of CT by Volhard's method
5. Estimation of CT by Fajan's method.
6. Estimation of  $\text{Cu}^{++}$  by EDTA.

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Organic Chemistry Practicals

1. Qualitative analysis of organic compounds:-

(At least six)

Preliminary tests, Detection of Elements, functional groups, M.P./ B.P. & structure.

Acids : Acetic acid, Oxalic acid, succinic acid, Benzoic Acid, Cinnamic acid, phthalic acid, Salicylic acid, P-nitro benzoic acid.

Bases : P-toludine, Aniline, O, m, p-nitroanilines, Diphenl amine, Dimethylamines.

Phenols: Phenol, ~~1-naphthol~~, <sup>β</sup> naphthol, O-Nitro-phenol, m-nitrophenol.

Neutral : Benzaldehyde, Acetone, Acetophenone, Benzophenone, Urea, Chloroform, Thiourea, Chloral, Glucose, Methyl alcohol, Ethyl alcohol, Ethyl acátate, Acetgnilide, Benzamide, Nitrobenzimid, Nitrobenzime, M-denitro benzene, Naphthalene Anthracene.

2. Crystalization of organic solids (including m.p.)

3. Distilation of organic liquids (including B.P.)

4. Preparation of (1) Benzoic acid from ethyl benzoate.

and

(2) Acetanilide from Aniline

OR

(3) Aspirin from saticylic acid.

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