

॥ अक्षरी पेटवू ज्ञानज्योत ॥

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North Maharashtra University,
Jalgaon.

Syllabus for S.Y.B.Sc.

CHEMISTRY

W.E.From June, 2003

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NORTH MAHARASHTRA UNIVERSITY, JALGAON.
Syllabus For S.Y.B.Sc.
CHEMISTRY.
(W.E.F. June, 2003)

S.Y.B.Sc. Paper-I [Physical and Analytical Chemistry]

• **Physical Chemistry**

1. **Free Energy and Equilibrium:** (16)

Introduction, The Helmholtz free energy and its change for reactions, The Gibb's free energy and its change for reactions, Properties and significance of Gibb's free energy change, Calculation of free energy changes, The fugacity and activity concept, Standard state for gases, solids and liquids, The reaction isotherm, Standard free energy of formation, Criteria of equilibrium.

Physical equilibria involving pure substances, Clapeyron equation and its use, Clausius-Clapeyron equation, Vapour pressure of liquid and its determination by isoteniscope method, Variation of vapour pressure with temperature, The boiling points of liquids- Trouton's rule.

Ref. 1: Pages 189 to 204, 206 to 220

Ref. 2: Relevant pages

2. **Electrochemistry I:** (14)

Reversible and irreversible cells, Electromotive force and its measurement, Standard cells, Cell reaction and Emf, Convention regarding sign of Emf, Single electrode potentials, Standard hydrogen and Calomel reference electrodes, Free energy, enthalpy and entropy change for cell reaction from Emf data, Electrode potentials and cell Emf as a function of initial and final activities of substances involved in cell reactions, Standard potentials and equilibrium constants, Classification of electrodes.

Ref. 1: Pages 471 to 487, 491 to 497

Ref. 2: Relevant pages

3. **Electrochemistry II:** (10)

Electrolytic conductance, Determination of conductance, Variation of conductance with concentration, Equivalent conductance at infinite dilution (Kohlrausch's law and its application), Applications of conductance measurements- A) Solubility of difficultly soluble salts, B) Determination of degree of ionization, C) Conductometric titrations.

Ref. 1: Pages 414 to 423, 431 to 434

Ref. 2: Relevant pages

4. **Solutions:** (12)

Introduction, Factors affecting solubility, Types of solutions, Ideal solutions, The vapour pressure of ideal solutions, The vapour pressure of actual liquid pairs, Boiling point diagrams of miscible binary mixtures, Azeotropes, The fractionating column, Solubility of partially miscible liquid pairs, Vapour pressure and distillation of immiscible liquids.

Ref. 1: Pages 261 to 264, 270 to 281, 284 to 292, 294 to 296.

Ref. 2: Relevant pages

• **Analytical Chemistry**

5. **Data Handling:** (6)

Accuracy and precision, Significant figures, Rounding off, Determinate and indeterminate errors, Ways of expressing accuracy, Problems on significant figures, Relative errors and absolute error.

Ref. 3: Pages 14 to 23

6. **Acid base equilibria:** (12)
 Acid – base theories, Acid – base equilibria in water, The P^H scale, Weak acids and bases, Salts of weak acids and bases, Buffers, Related problems.
 Ref. 3: Pages 172 to 195
7. **Acid base titrations:** (8)
 Strong acid verses strong base, Detection of end point- Indicators, Weak acid verses strong base, Weak base verses strong acid.
 Ref. 3: Pages 220 to 233
8. **Precipitation titrations:** (8)
 Precipitation reactions, Determination of end point in precipitation reactions, Preparation of 0.1M Silver nitrate solution, Standardization of 0.1M Silver nitrate solution, Determination of chloride by Volhard's method.
 Ref. 4: Pages 340 to 351, 355
9. **Redox titrations:** (12)
 Balancing reduction-oxidation reactions, Detection of end points, Titrations involving Iodine- Iodimetry and Iodometry, Titrations with other oxidizing agents such as $KMnO_4$, $K_2Cr_2O_7$ & $CeSO_4$
 Ref. 3: Pages 346 to 351, 358 to 368
10. **Chromatographic methods:** (6)
 Principles of chromatography, Classification of chromatographic techniques, Paper chromatography, Thin layer chromatography.
 Ref. 3: Pages 505 to 508, 550 to 555

References:

- Ref. 1: Principles of physical chemistry
 Fourth edition, By S.H. Maron and C.F. Prutton
 Oxford and IBH publishers
- Ref. 2: Elements of physical chemistry
 Second edition, By S. Glasstone and D. Lewis
 MacMillan and Co. Ltd. London
- Ref. 3: Analytical chemistry
 Fifth edition, By G.D. Christian
 Wiley international edition
 John Wiley and sons Inc.
- Ref. 4: Vogel's text book of quantitative chemical analysis
 Fifth edition, Orient Longmann Ltd.

S.Y.B.Sc. Paper-II [Organic and Inorganic Chemistry]

• Organic Chemistry

1. **Stereo isomerism: Definition, Types of isomerism** (17)
 - A. Optical isomerism: Tetrahedral carbon, Optical activity, Polarimeter, Specific rotation, Enantiomerism, Enantiomerism and Optical activity, Chirality, Chiral centre, Prediction of optical activity, Elements of symmetry, Racemic modification, Configuration, R and S Configuration.
Ref. 1: Pages 123 to 133, 136, 138 to 141.
 - B. Conformational isomerism [in Ethane, Propane, Butane, Cyclohexane]: Definition, Conformational isomers, Structure of ethane, Free rotation about carbon – carbon single bond, Conformations, Torsional strain, Propane and butane, Conformation of n-butane and propane.
Ref. 1: Pages 76 to 83, 147 to 148.
Cyclohexane: Factors affecting stability of conformations, Conformations of cyclohexane, Axial and equatorial bonds in cyclohexane.
Ref. 1: Pages 446 to 455.
 - C. Geometrical isomerism in oximes and compounds containing carbon – carbon double bond ($>C=C<$): Definition, Geometrical isomerism in $>C=C<$ Conditions for geometrical isomerism, Cis-trans and E/Z nomenclature, Geometrical isomerism in oximes.
Ref. 1: Pages 255 to 257.
Ref. 2: Pages 318 to 321.
2. **Reaction mechanism:** (4)
 - a. Electrophilic aromatic substitution reactions- Sulphonation, Halogenation, Friedel-craft acylation with mechanism.
Ref. 4: Pages 138 to 140, 143 to 146.
3. **A) Chemistry of polycyclic compounds:** (10)

Structure of naphthalene, Haworth synthesis, Reactions of naphthalene- Oxidation, Reduction, Nitration, Halogenation, Sulphonation, Friedel-craft acylation.
Ref. 1: Pages 1169 to 1172, 1187.

B) Chemistry of heterocyclic compounds:

 - I) **Five membered heterocyclic compounds:**
 - a. Furan- Synthesis from mucic acid, furfural.
 - b. Thiophene- Synthesis from acetylene, n-butane.
 - c. Pyrrole- Synthesis from acetylene, furan.
 - d. Reactions of Furan, Thiophene, Pyrrole- Sulphonation, Friedel-craft acylation, Hydrogenation, Reimer-Tiemann reaction.
 - II) **Six membered heterocyclic compounds:**
 - a. Pyridine- Synthesis from acetylene, pentamethylene diamine.
 - b. Reactions of pyridine- Nitration, Sulphonation, Bromination, Hydrogenation.
Ref. 3: Pages 828 to 854.
4. **Study of synthetic reagents:** (4)
 - a. Preparation and synthetic applications of Malonic ester, Use of Malonic ester to prepare Valeric acid, Dicarboxylic acids, Beta-keto acids, Alpha, Beta-unsaturated acids.
 - b. Preparation of Grignard reagent: Use of Grignard reagent to prepare Primary, secondary, tertiary Alcohols, Aldehydes, Ketones, Carboxylic acids, Hydrocarbon, amines.
Ref. 1: Pages 1060 to 1063.
Ref. 3: Pages 424 to 432.

5. **Agrochemicals:**

(4)

Definition, Synthesis and use of following agrochemicals-

- a. Lindane b. D.D.T. c. Parathion d. Endosulphon
 e. 2,4-D f. Indole acetic acid. g. Naphthyl acetic acid.

Ref. 5: Relevant pages.

6. **Ultra Violet Spectroscopy:**

(6)

- i. Introduction, Beer's law, Different types of excitations.
 ii Chromophore, Auxochrome, Bathochromic shift, Hypsochromic shift, Hypochromic shift, Hyperchromic shift.
 iii. Effect of conjugation on UV band.
 iv Calculation of λ_{max} by Woodward & Fischer rules for diens & enones.
 v. Application of UV spectroscopy: Structure determination, Stereochemistry (Cis- Trans)

Ref. 6: Relevant Pages.

Ref. 7 : Relevant Pages.

Ref. 8: Relevant Pages .

7. **Polymer chemistry:**

(7)

- a. Introduction to polymers
 Ref. 9: 1.1
 b. Classification of polymers
 Ref. 9: 1.5- 1,2,3,4,6.
 c. Synthesis and uses of following polymers- Low-density polyethylene, PVC, Polystyrene, Teflon, Polybutadiene.
 Ref. 1 and 9: Relevant pages.

• **Inorganic Chemistry**8. **Molecular orbital theory:**

(16)

Molecular orbital method, LCAO (linear combination of atomic orbitals) method, S-S, S-P, P-P, P-d, d-d combinations of orbitals, Non bonding combinations of orbitals, Rules for linear combination of atomic orbitals, Examples of molecular orbital treatment for homonuclear diatomic molecules of first and second short period elements in the periodic table (H_2 to F_2 molecules) and hetero nuclear diatomic molecules (NO, CO, HCl)
 Ref. 10: Pages 89 to 112.

9. **Solvents, Solutions, Acids and Bases:**

(6)

Solvent properties, Donor and acceptor properties, Protic solvents, Aprotic solvents, Definitions of acids and bases, Steric effects, Hard and soft acids and bases, Super acids.
 Ref. 11: Pages 163 to 173, 177 & 178.

10. **Zinc group:**

(6)

Electronic structures, Introduction, Extraction and uses, Oxidation states, Size, Ionisation energies, General properties, Complexes, Hg (I) compounds & evidences of Hg (I), Biological role of zinc, Toxicity of Cd and Hg.
 Ref. 10: Pages 835 to 842, 845 to 849 & 851 to 853.

11. **Principles in metallurgy:**

(10)

Metallurgy- Introduction, Occurrence of metals, Types of ores, Operations involved in metallurgy- Crushing, Hand picking, Concentration, Gravity separation, Leaching, Magnetic separation, Froth floatation process, Calcination, Roasting, Reduction, Refing, Type of flux, Clay.

Ref. 12: Pages 326 to 334.

Ref. 13: Pages 262 onwards.

Ref. 15: Point 2 & 3 onwards

12. Metallurgy of Iron and Steel (Pyrometallurgy): (6)

Occurrence, Concentration, Calcination, Smelting, Physico-chemical principles, Reactions in Blast furnace, Wrought iron, Manufacture of steel, Bessemer process, Heat treatment, Alloys of steel, Composition and applications.

Ref. 13: Pages 830 to 849.

13. Chemistry in the atmosphere: (8)

a. Earth's atmosphere, Nitrogen cycle, Oxygen cycle, Depletion of Ozone, Valcano's green house effect, Acid rain.

b. Indoor pollution- Risk from random, CO and CO₂.

Ref. 14: Pages 708 to 711, 714 to 727, 729 to 732.

References:

1. Organic chemistry
Fifth edition, Morrison and Boyd.
2. Stereochemistry of carbon compounds
E.L.Eliel.
3. Organic chemistry
Sixth edition, Vol-I, I.L.Finar.
4. A Guide book to reaction mechanism
Sixth edition, Peter Skyes.
5. Organic chemistry
Sixth edition, Vol-II, I.L.Finar.
6. Spectroscopic methods in organic chemistry
Fourth edition, D.H.Williams and I. Fleming.
7. Spectroscopy of organic compounds- P.S.Kalsi
8. Spectrometric identification of organic compounds
Fourth edition, Silverstein, Bassler & Morrill.
9. Polymer chemistry
First edition, M.G.Arora and M.Singh.
10. Concise Inorganic chemistry
Fourth / Fifth edition, J.D.Lee.
11. Basic Inorganic chemistry
F.A.Cotton, G.Wilkinson
Wiely Eastern Ltd.
12. Principles of Inorganic chemistry
B.R.Puri and L.R.Sharma
Vishal publications-Jullunder, Delhi.
13. Advanced Inorganic chemistry
Satyaprakash, Tuli and Basu
14. Chemistry
Fifth edition, Raymond Chang
15. A text book of Inorganic chemistry
P.L.Soni.

S.Y.B.Sc. Chemistry Practical Course

I) Physical Chemistry Experiments: (Any five)

1. Determination of transition temperature of the given substance by thermometric/dilatometric method ($\text{MnCl}_2, 4\text{H}_2\text{O} / \text{SrBr}_2, 2\text{H}_2\text{O} / \text{NaBr} \cdot 2\text{H}_2\text{O}$).
2. To determine critical solution temperature of phenol-water system.
3. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
4. Determination of solubility of sparingly soluble salt at room temperature by conductance measurement.
5. Determination of dissociation constant of weak acid (CH_3COOH) by conductometry.
6. Determination of normality of weak acid by titrating it conductometrically with strong base.
7. Determination of standard electrode potential of following electrodes using calomel as reference electrode- Cu/Cu^{++} , Ag/Ag^+ , Mg/Mg^{++} .

II) Inorganic Chemistry Experiments:

A) Volumetric Analysis: (Any five)

1. Determination of acetic acid in commercial vinegar using NaOH .
2. Determination of alkali contents- antacid tablet using HCl .
3. Estimation of Magnesium in talcum powder by using EDTA .
4. Determination of volume strength of H_2O_2 .
5. Estimation of chloride by Mohr's method.
6. Estimation of aspirin in a given drug sample.
7. Estimation of ferrous and ferric by dichromate method.

B) Gravimetric Analysis: (Any Two)

1. Analysis of Cu as CuSCN .
2. Analysis of Ni as Ni-DMG .
3. Analysis of Ba as BaSO_4 .

III) Organic Chemistry Experiments:

A) Organic Qualitative Analysis: (At least six compounds)

Preliminary tests, Type determination, Element detection, Functional group test, Determination of physical constant M.P./B.P.

1. Acids: Benzoic acid, Salicylic acid, Oxalic acid, Acetic acid.
2. Phenols: α -Naphthol, β -Naphthol, Resorcinol, Ortho, Meta and Para- Nitrophenols.
3. Bases: Aniline, P-Toluidine, Ortho, Meta and Para- Nitroanilines
4. Neutrals: Acetone, Urea, Ethyl acetate, Thiourea, Naphthalene, Benzaldehyde, Chlorobenzene, Nitrobenzene, m-dinitrobenzene, Acetanilide.

B) Preparation of Derivatives: Purification and determination of physical constants (Any Two)

1. Preparation of benzoyl derivative of phenol/amine.
2. Preparation of semicarbazone derivative of aldehyde/ketone.
3. Preparation of 2,4-Dinitrophenyl hydrazone derivative of aldehyde/ketone.

C) Laboratory Techniques: Thin layer chromatography (Any One)

1. Separation of Anthocyanin pigments from flowers.
2. Separation of binary mixtures of isomers- a) Ortho-nitrophenol & Para- nitrophenol
b) Ortho-nitroaniline & Para- nitroaniline.
 R_f values and identification.

D) A Visit to a Chemical Industry: At least one industry.

References:

1. Vogel's text book of quantitative inorganic analysis (Revised)
J.Bassette, R.C.Denney, G.H.Jeffery, J. Mendham. ELBS.
2. Experimental inorganic chemistry
W.G.Palmer, Cambridge.
3. Experimental organic chemistry
Vol. I & II Brauer, Academic press.
4. Vogel's text book of practical organic chemistry
B.S.Furniss, A.J.Hannaford, V.Rogers, P.W.G.Smith, A.R.Tatchell. ELBS
5. Experiments in physical chemistry
R.C.Das, B.Behra. Tata McGraw Hill
6. Advanced experimental chemistry: Vol. I -Physical
J.N.Gurtu & R. Kapoor, S.Chand & Co.
7. Selected experiments in physical chemistry
N.G.Mukherjee, J.N.Ghosh & Sons.
8. Experiments in physical chemistry
J.C.Ghosh, Bharti Bhavan.
9. Practical chemistry
Dr.C.M.Bhavsar, Nirali Prakashan.

EXAMINATION STRUCTURE

1. Paper – I : Physical & Analytical Chemistry -

There will be six questions. Four questions will carry 16 marks & Two questions 18 marks each. The question paper should include 20 to 25% weightage for numerical problems. The distribution of questions & marks will be as under

- i. Physical Chemistry (Chapters 1 to 4) : Two questions of 16 marks each & One question of 18 marks.
- ii Analytical Chemistry (Chapters 5 to 10) : Two questions of 16 marks each & One question of 18 marks.

❖ Topic wise division of marks: (Variation of $\pm 5\%$)

Chapter Number	Title	Marks Out of 100	Total marks with internal options
1	Free energy & equilibrium	16	24
2	Electrochemistry- I	12	18
3	Electrochemistry- II	10	15
4	Solutions	12	18
5	Data handling	06	09
6	Acid - base equilibria	10	15
7	Acid - base titrations	08	12
8	Precipitation titrations	08	12
9	Redox titrations	10	15
10	Chromatographic methods	08	12
Total		100	150

EXAMINATION STRUCTURE

2. Paper – II : Organic & Inorganic Chemistry -

There will be six questions. Four questions will carry 16 marks & Two questions 18 marks each.

The distribution of questions & marks will be as under

- i. Organic Chemistry (Chapters 1 to 7) : Two questions of 16 marks each & One question of 18 marks.
- ii. Inorganic Chemistry (Chapters 8 to 13) : Two questions of 16 marks each & One question of 18 marks.

❖ **Topic wise division of marks: (Variation of $\pm 5\%$)**

Chapter Number	Title	Marks Out of 100	Total marks with internal options
1	Stereoisomerism	16	24
2	Reaction mechanism	04	06
3	Chemistry of polycyclic & heterocyclic compounds	08	12
4	Study of synthetic reagents	05	08
5	Agrochemicals	04	06
6	U.V. spectroscopy	06	09
7	Polymer chemistry	07	10
8	Molecular orbital theory	16	24
9	Solvents, solutions, acids & bases	06	09
10	Zinc group	06	09
11	Principles in metallurgy	08	12
12	Metallurgy of iron & steel	06	09
13	Chemistry in the atmosphere	08	12
	Total	100	150

SCHEME FOR PRACTICAL EXAMINATION

The examination will be of six & half hours duration, 10:00 a.m. to 1:00 p.m. and 2:00 p.m. to 5:30 p.m. It will be conducted as follows

1. **Physical chemistry experiment** : 25 Marks
 2. **A) Inorganic volumetric analysis** : 25 Marks

OR

- B) Gravimetric analysis** : 25 Marks
 3. **A) Organic qualitative analysis** : 25 Marks

OR

- B) Preparation of derivative** : 15 Marks

And

- C) Laboratory techniques** : 10 Marks
 4. **Industrial visit report** : 10 Marks
 5. **Oral** : 05 Marks
 6. **Journal** : 10 Marks

Total : 100 Marks

Instructions:

1. A Batch of 15 students will be divided into Two groups and will be allotted exercise as follows

Time of allotment	Group I	Group II
10:00 a.m.	Question Number 1	Question Number 2
11:00 a.m.	Question Number 3 A	Question Number 3 B & C
02:00 a.m.	Question Number 2	Question Number 1

2. All three exercises should be written in separate answer books and will be collected at 5:30 p.m.
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