

North Maharashtra University, Jalgaon

S. Y. B. Sc Syllabus



Subject- Chemistry

From- June 2013

North Maharashtra University, Jalgaon.

Class- S. Y. B. Sc. (Semester Pattern) (With effect from June 2013)

In the Joint meeting of Chairman of Board of studies in all subjects of science Faculty chaired by Hon. Dean of Science faculty was held on 30 April, 2013, the revised syllabus for S. Y. B.Sc. (Chemistry) is accepted and finalised as per guidelines of Academic Council and with reference to the U.G.C. model curriculum. The nomenclature accepted is as follows.

CH-YSC [Y for year, S for semester and C for course number].

The course structure and title of the courses for S. Y. B. Sc. (Chemistry) are as given below

Course Title	Semester	Lectures	Marks	
			Ext.	Int.
CH 231: Physical and Inorganic Chemistry	I	60	40	10
CH-232:-Organic and Analytical Chemistry	I	60	40	10
CH-241:-Physical and Inorganic Chemistry	II	60	40	10
CH-242:-Organic and Analytical Chemistry	II	60	40	10
CH-203:-Chemistry Practical's	Annual	120	80	20

Note

1. Each course is having weight-age four lectures per week.
2. Each practical course is having weight age four lectures per week.
3. Examination of practical course shall be held at the end of the academic year.

**Chairman,
Board of Studies in Chemistry
North Maharashtra University, Jalgaon**

IMPORTANT NOTE

***In volumetric analysis, volume of pipette solution should be 10 ml instead of 25 ml. Similarly preparation of 100 ml solution by using 100 ml volumetric flask instead of 250 ml. (To avoid wastage of chemicals)**

***Examination Pattern. Chemistry Practical CH-203**

Instructions

1. Duration of examination – 10.00 am to 5.00 pm.
2. Question no. 1 should be given at 10.00 am to all students and answer books should be collected at 1.00 pm. Half of the students should be given physical chemistry experiment and remaining half should be given volumetric or gravimetric experiment.
3. Question no. 2 should be given at 2.00 pm and answer books should be collected at 5.00 pm.

1. Physical/ Volumetric/ Gravimetric Chemistry experiment	35 Marks
2. Qualitative analysis OR Inorganic Preparation OR Organic Preparation OR Chromatography	25 Marks
3. Oral	10 Marks
4. Journal	10 Marks
Total	80 Marks

Format of Question Paper S. Y. B. Sc.
CHEMISTRY PAPER-I CH-231 and CH-241
Physical and Inorganic chemistry

Instructions : 1. All questions are compulsory.
2. Programmable calculators are not allowed.

Q.1 A. Multiple choice questions (1 mark each) 4 Marks

1. Physical chemistry
2. Physical chemistry
3. Inorganic chemistry
4. Inorganic chemistry

B. Attempt any two (2 marks each) 4 Marks

1. Physical chemistry
2. Physical chemistry
3. Inorganic chemistry
4. Inorganic chemistry

Q.2 Attempt any two (4 marks each) 8 Marks

1. Physical chemistry.
2. Physical chemistry
3. Inorganic chemistry

Q.3. A. Answer any one (4 Marks each) 8 Marks

1. Physical chemistry (Numerical)
2. Physical chemistry (Numerical)

B. Answer any one (4 Marks each)

1. Inorganic chemistry
2. Inorganic chemistry

Q.4 Answer any two (4 marks each) 8 Marks

1. Physical chemistry
2. Inorganic chemistry
3. Inorganic chemistry

Q.5 A) Answer any one (6 marks) 8 Marks

1. Physical chemistry
2. Inorganic chemistry

B) Physical chemistry (2 marks)

CHEMISTRY PAPER II CH-232 and CH-242

Organic and Analytical Chemistry

Instructions : 1. All questions are compulsory.
2. Programmable calculators are not allowed.

Q.1 A. Multiple choice questions (1 mark each) 4 Marks

1. Analytical chemistry
2. Analytical chemistry
3. Organic chemistry
4. Organic chemistry

B. Attempt any two (2 marks each) 4 Marks

1. Analytical chemistry
2. Analytical chemistry
3. Organic chemistry
4. Organic chemistry

Q.2 Attempt any two (4 marks each) 8 Marks

1. Analytical chemistry.
2. Analytical chemistry
3. Organic chemistry

Q.3. A. Answer any one (4 Marks each) 8 Marks

1. Analytical chemistry
2. Organic chemistry

B. Answer any one (4 Marks each)

1. Analytical chemistry
2. Organic chemistry

Q.4 Answer any two (4 marks each) 8 Marks

1. Analytical chemistry
2. Organic chemistry
3. Organic chemistry

Q.5 A) Answer any one (6 marks) 8 Marks

1. Analytical chemistry
2. Organic chemistry

B) Analytical chemistry (2 marks)

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S. Y. B.Sc. Syllabus From June-2013

The Course Structure and title of the courses for S. Y. B.Sc. (Chemistry) are as given below:

Course	Title	Semester	Periods	Marks	
				External	Internal
CH-231	Physical and Inorganic Chemistry	I	60	40	10
CH-232	Organic and Analytical Chemistry	I	60	40	10
CH-241	Physical and Inorganic Chemistry	II	60	40	10
CH-242	Organic and Analytical Chemistry	II	60	40	10
CH-203	Practical Course Annual	Annual	120	80	20

Note:-

1. Each period is of 50 minutes. duration.
2. Each course is having weightage four periods per week.
3. Each practical course is having weightage four periods per week.
4. Examination of practical course shall be held at the end of the academic year.

Subject Title: Physical and Inorganic Chemistry

S.Y.B.Sc.

CH-231

Semester-I

Part I - Physical Chemistry

1.Solutions:

(M-11/16, P-16)

Introduction, Factors affecting solubility, Types of solutions, Different way of expressing the concentration of solution, , Ideal and non-ideal solutions Raoult's law and its limitation, The vapour pressure of actual liquid pairs the vapour pressure of ideal solution. Classification of binary solution of completely miscible liquids (Type-I, Type-II and Type-III) on the basis of Raoult's law), Boiling point diagrams of miscible binary mixtures, Distillation of binary miscible solutions, Azeotropes, the fractionating column, Solubility of partially miscible liquid pairs, Phase diagram Phenol water system, Triethylamine water and Nicotine water system

Ref.-1:- Pages 261-264,270-286,288-291

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Ref.-4:- Relevant Pages.

2.Colligative Properties:

(M- 9/14, P-14)

Introduction , Lowering of vapor pressure of solvent, Calculation of molecular weight from Lowering of vapor pressure of solvent. Boiling point elevation of solution, Calculation of molecular weight from boiling point elevation of solution, Freezing point depression of solution, Calculation of molecular weight from depression in Freezing point, Osmosis and osmotic pressure, Relation of osmotic pressure to vapour pressure, Van't Hoff equation for osmotic pressure, Landberger's method for the determination of elevation of boiling point, Beckman's method for determination of depression in freezing point ,Berkeley and Hartley's method, Solution of electrolyte, Colligative properties of electrolyte(Qualitative concept only), related numerical.

Ref.-1:- Pages 312-324,325-330

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Ref.-4:- Relevant Pages.

Part I - Physical Chemistry**1. Chemical Thermodynamics:** (M- 11/16 ,P-16)

Introduction, The Helmholtz free energy, ΔA for reactions, Gibbs free energy and, ΔG for reactions, Properties and significance of Gibbs free energy change, Calculation of free energy changes, Fugacity and activity concepts, The reaction isotherm, Standard free energy change of formation, Criteria of equilibrium.

Physical equilibria involving pure substances, Clapeyron equation and its use, Vapour pressure of liquid and variation of vapour pressure with temperature, Clausius-Clapeyron equation, Related numerical.

Ref.-1:- Pages 189--203,206-213 ,215-218

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Ref.-4:- Relevant Pages.

2. Electrochemistry (M- 9/14,P-14)

Introduction, Electromotive force and its measurements, Standard cell, Cell reaction and EMF, convention regarding sign of EMF, Single electrode potential, Standard hydrogen and calomel reference electrodes, Calculation of single electrode potential, Calculation of cell emf from single electrode potential, Thermodynamics and EMF, ΔG , ΔH , ΔS from EMF data, Thermodynamics of electrode potential (Nernst equation), Standard potential and equilibrium constant, Classification of electrodes, Related numericals.

Ref.-1:- Pages 481-497

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Reference books :-**1. Principles of Physical Chemistry**

S. H. Maron and C. F. Prutton (4th edition)

2. Essentials of Physical Chemistry

B. S. Bahl, G. D. Tuli, Arun Bahl (S. Chand and Co Ltd.) (25th edition)

3. Elements of Physical Chemistry

S. Glasstone and D. Lewis (The Macmillan Press Ltd.) (2nd edition)

4. Physical Chemistry

Robert A. Alberty (John Willey and Sons) (7th edition)

Part-II Inorganic Chemistry**1. The d –block elements****(M-11/16, P-16)**

- A. Elements of first, second and third transition series
- B. General characteristics of d-block elements- a) Metallic character b) Molar volume and densities c) Atomic radii d) Ionic Radii e) Melting and boiling points f) Ionization Energies g) Reactivity h) Oxidation states i) Standard electrode potential j) Reducing Properties k) Color l) Magnetic properties m) Catalytic Properties n) Tendency to form complexes.

Ref-4-Pages-615-624**Ref-1-653-655, 657-664, 671****Ref-5-1128-1143****2. The Metallic bond****(M-09/14, P-14)**

- a) General properties of Metals
- b) Conductivity, Luster, Malleability and cohesive forces
- c) Theories of bonding in metals- Free electron theory, Valence bond theory and Molecular orbital theory
- d) Conductors, Insulators and Semiconductors, Intrinsic and Extrinsic semiconductors
- e) Super conductivity and its applications.

Ref-1 pages-121-125, 127-133,140-144**Ref.-2 Pages 220, 221, 224-231.****Ref4 Pages 175-179****Ref-5 Pages 259-264**

Part-II Inorganic Chemistry

1. The f-block elements

(M-09/14, P-14,)

A] The Lanthanoid Series

- a) Electronic Structure
- b) Oxidation States
- c) Extraction from monazite sand with flow sheet
- d) Uses
- e) Lanthanoid contraction- Definition, causes, effects of lanthanoid contraction on chemistry of lanthanoids and post lanthanoid elements
- f) Separation of lanthanoids from one another by solvent extraction and ion exchange chromatography

B] The Actinoid series

- a) Electronic structure
- b) position in periodic table
- c) Oxidation states
- d) Occurrence of actinoids
- e) Preparation of actinoids using- i) Neutron bombardment ii) Accelerated Projectile bombardment iii) Heavy ion bombardment.

Ref-1 Pages-859,860,862,865,866,874,875,879-881,883-885

Ref-4 Pages-704-707,710-717

2. Molecular Orbital Theory (MOT)

(M-11/16, P-16)

- a) Molecular orbital method
- b) LCAO Method
- c) s-s, s-p, p-p, p-d and d-d combination of orbitals
- d) Non Bonding combination of orbitals
- e) Rules for linear combination of orbitals
- f) Molecular orbital treatment for Homo nuclear Diatomic species – $H_2, He_2, He_2^+, B_2, N_2$ and O_2
- g) Molecular orbital treatment for Hetero nuclear diatomic molecules – CO, NO, and HCl.

Ref-1 Pages-89-102,104-112

Ref-3 Pages-333,334, 337-342,344-346,349-351,353,354,357,358,361,362.

Reference Books

1. Concise Inorganic Chemistry By J. D. Lee, 5th edition
2. Theoretical Principles of Inorganic Chemistry By G.S. Manku Tata McGraw Hill edition
3. Advanced Inorganic Chemistry Volume-I by Satya Prakash, G.D. Tuli, S.K. Basu, R. D. Madan S. Chand & Company Ltd (2004)
4. Principles of Inorganic Chemistry By Sharma, Puri, Kalia 30th edition Milestone Delhi.
5. Advanced Inorganic Chemistry Volume-I by Gurdeep Raj 23rd edition , Goel Publishing House, Meerut.

Semester I

Subject Code CH-232

Subject Title: Organic and Analytical Chemistry

Semester I

Subject Code CH-232

Part-I Organic Chemistry

Chapter 1: Stereoisomerism

(M-9/12, P-12)

- a) Stereoisomerism, types of stereoisomerism.
- b) **Projection formulae** – Fischer projection formula, Newman projection formula, Saw horse formula.
- c) **Optical isomerism** – optical activity, enantiomerism, chiral centre and chirality, elements of symmetry, dextrorotatory, laevorotatory, Configuration- R and S nomenclature system.
- d) **Geometrical isomerism**- Geometrical isomers, condition for geometrical isomerism, nomenclature system - Cis and Trans, E and Z, Syn and Anti (for oximes)
- e) **Conformational isomerism**- conformational isomers, conformational isomerism in ethane and n- butane with energy profile diagrams.

Ref 2, 3, 4 (Relevant pages)

Chapter 2 : Electrophilic Aromatic Substitution

(M-4/7, P-7)

Introduction, general mechanism of electrophilic aromatic substitution, orientation of substitution in monosubstituted benzene.
Mechanism of nitration, sulphonation and halogenation.

Ref. 7, 2, 5

Chapter 3 : Aromatic compounds

(M-7/11, P-11)

a) Haloarenes

Introduction, reactions of haloarenes - nucleophilic substitution reactions with $\text{NaNH}_2/\text{KNH}_2$, NaOH , NH_3 , CuCN , Ullman reaction.

b) Phenols

Introduction, nomenclature, acidity of phenols.

Preparation of phenol from benzene sulphonic acid, benzene diazonium chloride.

Reactions- ester formation (acylation), formation of aryl ethers, Fries rearrangement.

c) Aromatic amines

Preparation of aniline- from chlorobenzene, nitrobenzene,
Basicity of aromatic amines. Reactions- benzylation, N alkylation,
Preparation of benzene diazonium chloride, reactions of benzene diazonium chloride-
formation of iodobenzene, Sandmeyer reaction, azo coupling reaction (formation of
methyl orange).

d) Aromatic aldehydes and ketones

Preparation of benzaldehyde- Gatterman Koch reaction, by oxidation of toluene.
Reactions- addition of HCN, addition of Grignard's reagent, benzoin condensation,
crossed aldol condensation, crossed Cannizzaro reaction.
Preparation of acetophenone- by oxidation of ethyl benzene, by F C acylation.
Reactions- addition of HCN, addition of Grignard's reagent, oxime formation.

e) Aromatic carboxylic acids

Preparation of benzoic acid- by hydrolysis of phenyl cyanide, by carbonation of
Grignard's reagent.
Reactions of benzoic acid- formation of salt, benzoyl chloride, benzamide, reduction to
benzyl alcohol.

Ref 1,2,5,6 (Relevant pages)

Semester II

Subject Code CH-242

Part-I Organic Chemistry

Chapter 1 : Synthetic Reagents

(M-7/10, P-10)

a) Acetoacetic ester

Preparation of acetoacetic ester and synthesis of- alkyl acetic acid, dialkyl acetic acid,
succinic acid, adipic acid, α - β unsaturated acid, methyl ketone (butanone).

b) Malonic ester

Preparation of malonic ester and synthesis of- alkyl acetic acid, dialkyl acetic acid,
succinic acid, glutaric acid, β keto acid(acetoacetic acid), α - β unsaturated acid.

Ref. 1, 2, 5, 6 (Relevant pages)

Chapter 2 : Heterocyclic and polycyclic compounds

(M-8/11, P-11)

a) Heterocyclic compounds

Preparation of furan, pyrrole and thiophene. Reactions- sulphonation, F C acylation, Reimer Tiemann reaction, catalytic hydrogenation.

Preparation of pyridine- from pentamethylene diamine hydrochloride, from picoline. Reactions- nitration, sulphonation, bromination, catalytic hydrogenation.

b) polycyclic compounds

Structure of naphthalene, Haworth synthesis. Reactions- oxidation, reduction, nitration, halogenations, sulphonation, F C acylation.

Ref. 1, 2, 5, 6, 8 (Relevant pages)

Chapter 3 : Organometallic compounds

(M-5/9, P-9)

Nomenclature, carbon-metal bond in organometallic compounds, preparation of organolithium compounds, Preparation of alcohols from organolithium compounds, preparation of Grignard's reagent, reactions of Grignard's reagent with- esters, acid chlorides, with compounds containing active hydrogen, synthesis of organocopper compounds (Lithium dialkyl cuprate) and synthesis of alkanes, Reformatsky reaction.

Ref. 1, 2, 5, 6 (Relevant pages)

Reference Books

- 1) Organic chemistry - Francis A Carey (3rd Edition)
- 2) Organic chemistry - Morrison and Boyd (6th Edition)
- 3) Stereochemistry of organic compounds- E L Eliel
- 4) Stereochemistry of organic compounds- P S Kalsi
- 5) Organic chemistry - Stanley H pine (5th Edition)
- 6) A Text book of Organic chemistry- Arun Bahl and B S Bahl, S Chand publication.
- 7) A guide book to reaction mechanism in organic chemistry by Peter Sykes.5th Ed.
- 8) Heterocyclic compounds by Leo Packet.

Semester I

Subject Code CH-232

Part-II Analytical Chemistry

Chapter 1: Introduction to Analytical Chemistry

(M-7/10, P-10)

- a) Analytical chemistry, importance of analytical chemistry, types of analysis- qualitative and quantitative analysis, instrumental methods of analysis- classification.
- b) Sampling – Definition, procedure of sampling, types of sampling, precautions and hazards in sampling.
- c) Accuracy, precision, ways of expressing accuracy- absolute error, mean error, relative error, relative accuracy, ways of expressing precision- average deviation and standard deviation, significant figures, significance of zero, rounding off.
- d) Errors – Definition, types of errors, minimisation of errors.

Ref.1- 1, 2, 4, 14-16, 20-25

Ref.2- 1, 2, 5, 6,158,159,161,104-112

Ref.4- 3, 7, 127-135, 150-151, 155-156, 851-853

Ref.3, 5, 6, 7- Relevant pages

Chapter 2 : Acid – Base Titrations

(M-7/10,P-10)

- a) Principle and concept of change in pH during acid – base titrations.
- b) Acid–base indicators, Henderson-Hasselbalch equation, transition range of indicators.
- c) Study of acid base titrations with respect to- neutralisation curve, selection of indicators and calculation of pH in different stages-
 - i) Strong acid versus strong base
 - ii) Weak acid versus strong base
 - iii) Strong acid versus weak base
- d) Applications of acid base titrations (in brief).

Ref.1- 220-233, 690-696(for brief applications)

Ref.2- 296-300, 302-308

Ref.4- 262-265, 269-275

Ref.3, 5, - Relevant pages

Chapter 3 : Precipitation Titrations

(M-6/10,P-10)

- a) Principle, precipitation titration curve.
- b) Detection of end point in precipitation titrations- K_2CrO_4 (Mohr's method), Ferric alum(Volhard's method), Adsorption indicators(Fajan's method)
- c) Preparation of $AgNO_3$ solution- from metallic silver and from solid $AgNO_3$,

Standardisation of AgNO_3 solution- by Mohr's method, limitations of Mohr's method.

d) Estimation of halides- by Fajan's method and Volhard's method.

e) Applications of precipitation titrations (in brief).

Ref.1- 277-281, 702-704(for brief applications)

Ref.2- 345-355

Ref.4- 340-350

Ref.3, 5, - Relevant pages

Semester II

Subject code CH-242

Part-II Analytical Chemistry

Chapter 1 : Redox Titrations

(M-7/10, P-10)

a) Oxidation, reduction, redox reaction, oxidising agents, reducing agents, oxidation number, redox titrations.

b) Titration of Ce (IV) and Fe (II), nature of titration curve, calculation of emf in different stages.

c) Detection of end point- redox indicators, self indicator and starch indicator.

d) Iodimetry, pH conditions, limitations.

Iodometry, standardisation of sodium thiosulphate by potassium dichromate, estimation of Cu (II).

e) Preparation of potassium permanganate solution and its standardisation, estimation of Fe (II)

f) Applications of redox titrations (in brief).

Ref.1- 284-285 354-367, 708-718(for brief applications)

Ref.2- 767-768, 358-366, 373-380

Ref.4- 360-362, 364-371, 384-394

Ref.3, 5, - Relevant pages

Chapter 2 : Complexometric Titrations

(M-5/9, P-9)

a) Complexes, ligands, types of ligands, chelates, chelating agents.

b) Formation of a complex, formation constant, chelon effect.

c) Chelating agent EDTA, EDTA equilibria, EDTA titration curve.

- d) Detection of end point- indicators, principle involved in colour change of indicator, characteristics of metal ion indicators, Eriochrome black T indicator.
- e) Applications of complexometric reactions and titrations (in brief).

Ref.1- 250-263, 696-701(for brief applications)

Ref.2- 326-328, 330-334, 42, 206

Ref.3, 4, 5, - Relevant pages

Chapter 3: Chromatography

(M-8/11, P-11)

- a) Introduction, advantages and disadvantages of chromatography.
- b) Principle of chromatography, classification of chromatographic methods- partition, adsorption and ion exchange chromatography.
- c) Paper chromatography- principle, technique, R_f value, ascending and descending techniques, applications.
- d) Thin layer chromatography- principle, technique and applications.
- e) Column chromatography- principle, technique and applications.

Ref.1- 505-510, 550-554

Ref.2, 3, 4, 5, - Relevant pages

Reference Books

- 1) Analytical chemistry – G D Christian (5th Edition).
- 2) Quantitative chemical analysis- J Mendham, R C Denny, Barnes, Thomas
- 3 Analytical chemistry- D A Skoog, D M West, F J Holler
- 4) Vogel's text book of quantitative inorganic analysis- Bassett, Denney, Jeffrery
- 5) Basic concepts of analytical chemistry- S M Khopkar.
- 6) Introduction to instrumental analysis- Robert D Braun
- 7) Instrumental analysis- Skoog, Holler, Crouch

NORTH MAHARASHTRA UNIVERSITY, JALGAON

S. Y. B. Sc.

Subject Title: Chemistry Practical (CH-203)

A) PHYSICAL CHEMISTRY EXPERIMENTS

(4 out of 6)

Non instrumental (any 2)

1. Determination of molecular weight of solute (acetanilide/ m -dinitrobenzene /sulphur) by depression of freezing point method.
2. Determination of molecular weight of non-volatile solute (KCl/ BaCl₂/ Urea) by using Landsbergers apparatus.
3. Determination of critical solution temperature of phenol-water system.

Instrumental (any 2)

1. Determination of standard electrode potential of Cu/Cu⁺² or Ag/Ag⁺, Zn/Zn⁺² electrodes potentiometrically.
2. Determination of normality and strength of HCl titrating with standard NaOH Potentiometrically.
3. Determination of solubility of sparingly soluble salts (BaSO₄/ PbSO₄) conductometrically.

B) VOLUMETRIC ANALYSIS

(4 out of 6)

1. Estimation of acetic acid in commercial vinegar using NaOH.
2. Estimation of aspirin in drug sample.
3. Estimation of alkali content in antacid tablet using HCl.
4. Determination of volume strength of H₂O₂.
5. Estimation of copper iodometrically.
6. Estimation of Mg⁺² by complexometric titration with EDTA.

C) PREPARATIONS

(4 out of 6)

Organic (any 2)

1. Benzoyl derivative of -OH / -NH₂.
2. 2, 4 DNP derivative of >C=O.
3. Benzoic acid from benzamide

Inorganic (any 2)

1. Tetramine Cu (II) sulphate.
2. Hexamine Ni (II) chloride.
3. Ferrous ammonium sulphate (Mohr's salt).

D) ORGANIC QUALITATIVE ANALYSIS

(any 4 compounds)

Determination of

1. Type
2. Preliminary tests
3. Physical constant (melting/ boiling point)
4. Elements (Sodium fusion test)
5. Functional groups
6. Structure

E) GRAVIMETRIC / CHROMATOGRAPHY

(4 out of 6)

Gravimetric analysis (any 2)

1. Estimation of Ni as Ni-DMG (by counterpoise method)
2. Estimation of Ba as BaSO₄ (by ignition using filter paper)
3. Estimation of Pb as PbCrO₄ (by Gooch crucible)

Chromatography (any 2)

1. Separation of mixture of o-nitroaniline and p-nitroaniline by Thin Layer Chromatography and to determine their R_f values.
2. Separation of mixture of any two amino acids by paper chromatography.
3. Separation of mixture of two sugars by paper chromatography.