KavayitriBahinabaiChaudhari
North Maharashtra University, Jalgaon
Syllabus
S.Y.B.Sc.
Subject: Chemistry
Choice Based Credit System

'A' Grade
NAAC Re-accredited
(3rd Cycle)

With Effect from June 2019

Prepared By
Chairman, Members of Board of Studies
And The Experienced Teachers in Chemistry,
North Maharashtra University, Jalgaon

KavayitriBahinabaiChaudhari
North Maharashtra University, Jalgaon
Revised Syllabus of S.Y.B.Sc. Chemistry (w.e.f. June 2019)
Choice Based Credit System (CBCS) Pattern

In the Faculty meeting chaired by Hon. Dean of Science faculty, the revised syllabus for S.Y.B.Sc. (Chemistry) is accepted and finalized as per guidelines of Academic Council and with reference to the U.G.C. model curriculum.
The course structure for S.Y.B.Sc. (Chemistry) is given below.

Course	Semester-III	Lectures	Marks		Credits
			Internal	External	
CH -301	Physical And Inorganic Chemistry (Core Course)	30	40	60	02
CH -302	Organic and Inorganic Chemistry (Core Course)	30	40	60	02
CH -303	Practical Chemistry	60	40	60	02
CH- 304 (SEC-1)	Basic Analytical Chemistry (Skill Enhancement Course)	30	40	60	02
	Semester- IV				
CH -401	Physical And Inorganic Chemistry (Core Course)	30	40	60	02
CH -402	Organic and Inorganic Chemistry (Core Course)	30	40	60	02
CH -403	Practical Chemistry	60	40	60	02
CH -404 (SEC-1I)	Advanced Analytical Chemistry (Skill Enhancement Course)	30	40	60	02

Note:
1. Each lecture is of one hour duration.
2. Each theory paper has two lectures per week.
3. Each practical course has four lectures per week.

Chairman B.O.S.Dean Science Faculty

KavayitriBahinabaiChaudhari
North Maharashtra University, Jalgaon
Revised Syllabus of Chemistry (w.e.f. June 2019)
Choice Based Credit System (CBCS) Pattern

Semester I

Core Course: CH - 301
Physical and Inorganic Chemistry

1. Solutions (L-10, M-20/30)

Introduction, Solubility,Factors affecting solubility, Types of solutions,Different way of expressing the concentration of solution , Ideal and non-ideal solutions, Raoults 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 Raoults 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, Tri ethyl amine-water and Nicotine-water system

Ref.1: Pages 261-264,270-286,288-291
Ref. 2, 3, 4 Relevant Pages

2.Colligative Properties (L-10, M-20/30)

Introduction, lowering of vapour pressure of solvent, Calculation of molecular weight of solute from Lowering of vapour pressure of solvent. Boiling point elevation of solution, Calculation of molecular weight of solute from boiling point elevation of solution, Freezing point depression of solution, Calculation of molecular weight of solute 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 ,Berkley and Hearty's method, Solution of electrolyte, Colligative properties of electrolyte (Qualitative concept only), related numerical.

Ref.-1:- Pages 312-324, 325-330
Ref. 2, 3, 4 Relevant Pages

3. The d-block elements (L-10, M-20/30)

Elements of first, second and third transition series, 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) Colour l) Magnetic properties

m) Catalytic Properties n) Tendency to form complexes

Ref. 5-653-671
Ref. 6 -615 -624
Ref. 7-1128-1143

Reference books

1. Principles of Physical Chemistry by S. H. Maron and C. F. Prutton (4th edition) 2015

2. Essentials of Physical Chemistry by B. S. Bahl, G. D. Tuli, ArunBahl, S. Chand (25th edn) Dec. 2010

3. Elements of Physical Chemistry S. Glasstone and D. Lewis (Macmillan Press Ltd.) (2nd edn) 2014

4. Physical Chemistry by Robert A. Alberty (John Willey and Sons) (7th edition) 1992

5. Concise Inorganic Chemistry by J.D.Lee.5th Edition. 2014

6. Principles of Inorganic Chemistry By Sharma, PuriKalia 30th edition Milestone Delhi. 2017

7. Advanced Inorganic Chemistry Volume - I, by Gurdeep Raj 23rd edition, Goel Publishing House, Meerut. 2016

Semester I

Core Course: CH - 302

Organic and Inorganic Chemistry

1: Stereoisomerism(L-12, M-24 / 36)

a) Isomerism, classification of isomerism, 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 systems: Cis and Trans, E and Z, Syn and Anti.

e) **Conformational isomerism**

Conformational isomers, conformational isomerism in ethane and n- butane with energy profile diagrams.

f) Stereochemistry of Cyclohexane

Conformations of cyclohexane: chair and boat forms, axial and equatorial bonds in cyclohexane, factors affecting stability of conformations. Mono substituted cyclohexane.

(Use of models / ICT is expected for teaching this chapter)

Ref 2, 3, 4 (Relevant pages)

2: Heterocyclic and polycyclic aromatic compounds (L-08, M-16/24)

a) Five membered ring with one heteroatom

Introduction, preparation of furan, pyrrole and thiophene. Reactions: nitration, sulphonation, F C acylation, Reimer Tiemann reaction, catalytic hydrogenation.

b) Six membered ring with one heteroatom

Preparation of pyridine: from acrolein and from acetylene. Reactions: nitration, sulphonation, bromination, catalytic hydrogenation.

b) Polycyclic aromatic compounds

Introduction, structure of naphthalene, Haworth synthesis. Reactions: oxidation, reduction, nitration, halogenations, sulphonation, F C acylation.

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

3: Solvents, solutions Acids and Bases (L-10, M-20 / 30)

a) Donar and acceptor properties.

b) Molten salts, solvents for electrochemical reactions, purity of solvents.

c) Definition and approaches, solvent system concept, Lux-flood concept, Lewis concept, Generalized Acid-base concepts.

d) Differentiating and levelling solvents.

e) Co-solvating agents.

f) Hard and soft acids and bases: definitions, Pearson HSAB concept, theories of Hardness and softness, application and limitation of HSAB concepts.

Ref. - 9 : Page Nos. 220, 221, 223-229, 234-236.
Ref. - 10 : Page Nos. 238-249, 255-258, 263, 266, 269, 270.
Ref. - 11 : Page Nos. 374-386.

Reference Books

1) Organic chemistry - Francis A Carey (3rd Edition) 2017
2) Organic chemistry - Morrison and Boyd (6thEdition) 2018
3) Stereochemistry of organic compounds- E L Eliel 2008
4) Stereochemistry of organic compounds- P S Kalsi 2009
5) Organic chemistry - Stanley H pine (5th Edition) 1987
6) A Text book of Organic chemistry- ArunBahl and B S Bahl, S Chand publication.2016
7) A guide book to reaction mechanism in organic chemistry by Peter Sykes.5th Ed. 2003
8) Heterocyclic compounds by Leo Packet. 2006
9) Basic Inorganic chemistry 3rd edition by F.A. cotton, G. Wilkinson, Paul Guss John Wiley and Sons. 2007
10) Theoretical principals of Inorganic chemistry by G.S. Manku, Tata Mc. Graw Hill edition.
11) Advanced Inorganic chemistry by Gurudeep Raj., Vol. I, 23rd Edition, Goel publishing House Meerut.2015

Semester II

Core Course: CH- 401
Physical and Inorganic Chemistry

1.Electrochemistry (L-10, M-20/30)

Introduction, Electromotive force and its measurements , Reversible and Irreversible Cells, 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.

2.Chemical Thermodynamics (L-10, M-20/30)

Introduction, The Helmholtz free energy, ΔA for reactions, Gibb's free energy and, ΔG for reactions, Properties and significance of Gibb's free energy changes, 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 vapor pressure with temperature**,** Clausius-Clapeyron equation, Different form of ClausiusClapeyron equation and is applications, Related numerical.

Ref.-1:- Pages 189-203, 206-213, 215-218
Ref.-2:- Relevant Pages.
Ref.-3:- Relevant Pages.
Ref.-4:- Relevant Pages.

3: Basic concepts of coordination chemistry(L-07, M-14 / 21)

Double salts and coordination compounds, co-ordination complexes and complex ions, coordination number, Unidentate, bidentate and polydentate ligands, chelating ligand and chelates, physical methods used in study of complex, Nomenclature of coordination compounds.

Ref. - 5:Page Nos. 729-735, 738-741.
Ref. -6: Relevent Pages.

4: Conductors, Insulators & Semiconductors(L-03, M-07 / 09)

General Properties of metals. Conductors, insulators and semiconductors. Intrinsic and extrinsic semiconductors. Applications of semiconductors.

Ref. 6 -121 - 144
Ref. 7-220-231
Ref. 8-175-179
Ref. 9-259-264

Reference books

1. Principles of Physical Chemistry

S. H. Maron and C. F. Prutton (4th edition) 2012

2. Essentials of Physical Chemistry

B. S. Bahl, G. D. Tuli, ArunBahl (S. Chand and Co Ltd.) (25th edition) 2010

3. Elements of Physical Chemistry

S. Glasstone and D. Lewis (The Macmillan Press Ltd.) (2nd edition) 2014

4. Physical Chemistry

Robert A. Alberty (John Willey and Sons) (7th edition) 1992

5. Principals of Inorganic Chemistry by B.R.Puri, L.R. Sharma, K.C. Kalia, Milestone publishers and distributors. 2017
6. Concise Inorganic Chemistry by J. D.Lee. 5th Edition. 2014
7. Theoretical Principles of Inorganic chemistry by G.S.Manku Tata McGraw Hill edition.1982
8. Principles of Inorganic Chemistry By Sharma, PuriKalia 30th edition Milestone Delhi. 2017
9. Advanced Inorganic Chemistry Volume - I , by Gurdeep Raj 23rd edition , Goel Publishing House, Meerut. 2016

Semester II

Core Course:CH - 402
Organic and Inorganic Chemistry

1: Synthetic Reagents (L-10, M-20 / 30)

Introduction, active methylene group

a) Acetoacetic ester

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

b) Malonic ester

Preparation of malonic ester. Synthesis of- alkyl acetic acid, dialkyl acetic acid, succinic acid, glutaric acid, β keto acid(acetoacetic acid), ∝-β unsaturated acid.

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

2:Organometallic compounds(L-10, M-20 / 30)

a) Nomenclature of organometallic compounds, carbon-metal bond in organometallic compounds.

b)**Organolithium compounds**

Preparation of organolithium compounds, Preparation of alcohols from organolithium compounds.

c) **Organomagnesium compounds**

Preparation of Grignard's reagent, reactions of Grignard's reagent with- esters, acid chlorides, with compounds containing active hydrogen.

d) **Organocopper compounds**

Preparation of organocopper compounds (Lithium dialkylcuprate) and synthesis of alkanes.

e) **Organozinc compounds**

Preparation of organozinc compounds, synthesis of cyclopropanes (Simmon Smith reaction), Reformatsky reaction.

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

3. Molecular Orbital Theory (MOT) (L-10, M-20 / 30)

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 ,O_2 , O_2^- and O_2^{--}
g) Molecular orbital treatment for Hetero nuclear diatomic molecules –CO, NO, and HCl

Ref-9 Pages-89-102,104-112
Ref-10 Pages-333,334, 337-342,344-346,349-351,353,354,357,358,361,362

Reference Books

1)Organic chemistry - Francis A Carey (3rd Edition) 2017
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3)Stereochemistry of organic compounds- E L Eliel 2008
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7)A guide book to reaction mechanism in organic chemistry by Peter Sykes.5th Ed.2003
8) Heterocyclic compounds by Leo Packet. 2006

9) Concise Inorganic Chemistry By J. D. Lee, 5th edition 2014
10) Advanced Inorganic Chemistry Volume-I by SatyaPrakash, G.D. Tuli, S.K. Basu, R. D. Madan S. Chand & Company Ltd (2004)

Semester I

Skill Enhancement Course
SEC-1: Basic Analytical Chemistry

Chapter 1: Introduction to Analytical Chemistry(L-08, M-16/24)

a) Introduction: Analytical chemistry, its interdisciplinary nature, importance of analytical chemistry, types of analysis: qualitative and quantitative analysis

b) Concept of sampling, definition, procedure of sampling, types of sampling

c) Accuracy, precision, significant figures, significance of zero, rounding off

d) Errors: Definition, types and sources of errors, minimisation of errors.

e) Good laboratory practices: Material safety data sheet (MSDS), fire safety, Handling of chemicals

Ref. 1, 2, 3, 4, 5 (Relevant pages)

Chapter 2: Acid base titrations (L-08, M- 16/24)

a) Principle,Acid–base indicators, Henderson-Hasselbalch equation, transition range of indicators.

b) Study of following acid base titrations with respect to: neutralization curve, selection of indicators and calculation of P^H

i) Strong acid versus strong base

ii) Weak acid versus strong base

c) Applications of acid base titrations.

Ref. 1, 2, 3, 4, 5 (Relevant pages)

Chapter 3: Precipitation titrations (L-06, M- 12/18)

a) Principle, precipitation titration curve**,**use of indicators in detectionof end point.

b) Preparation of $AgNO_3$ solution, its standardisation by Mohr's method.

c) Estimation of halides by Fajan's method

d) Applications of precipitation titrations.

Ref. 1, 2, 3, 4, 5 (Relevant pages)

Chapter 4: Chromatography (L-08, M-16/24)

a) Definition, Introduction, advantages and disadvantages of chromatography.
b) Principle of chromatography, classification of chromatography - partition, adsorption and ion exchange chromatography.
c) Paper chromatography: principle, technique, Rf value, ascending and descending techniques, paper chromatographic separation of metal ions, applications.
d) Thin layer chromatography (TLC): principle, technique and applications.
e) Ion exchange (Column) chromatography- cation and anion exchange resins, principle, technique and applications.

Ref. 1, 2, 3, 4, 5 (Relevant pages)

Semester II

Skill Enhancement Course

SEC-2: Advanced Analytical Chemistry

Chapter 1: Redox titrations (L-10, M-20/30)

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

b) Titration of Ce (IV) versus Fe (II), nature of titration curve, calculation of emf during titration.

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

d) Titrations involving iodine: Iodimetry and Iodometry.

e) Determination of dissolved oxygen (DO) of a water sample.

f) Applications of redox titrations.

Ref. 1, 2, 3, 4, 5 (Relevant pages)

Chapter 2: Complexometric titrations (L-08, M- 16/24)

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

b) Formation of complex, formation constant.

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

d) Detection of end point- use of indicators, principle involved in colour change of indicator, characteristics of metal ion indicators.

e) Applications of complexometric titration with reference to analysis of soil: Estimation of calcium and magnesium ions by complexometric titrations.

Ref. 1, 2, 3, 4, 5 (Relevant pages)

Chapter 3: Gravimetric analysis (L-12, M- 24/36)

a) Introduction, advantages of gravimetric analysis

b) Solubility product (with problems), conditions for precipitation.

c) Steps of gravimetric analysis: Preparation of solution, precipitation, digestion.

Impurities in the precipitate: co-precipitation and post precipitation. Filtration, washing, drying or ignition, weighing

d) Applications – estimation of Ba as $BaSO_4$, Ni as Ni-DMG, Pb as $PbCrO_4$

Ref. 1, 2, 3, 4, 5 (Relevant pages)

Reference Books

1) Analytical chemistry – G D Christian (5^{th} Edition). 2006
2) Quantitative chemical analysis- J Mendham, R C Denny, Barnes, Thomas 2009
3 Analytical chemistry- D A Skoog, D M West, F J Holler 1992
4) Vogel's text book of quantitative inorganic analysis- Bassett, Denney, Jeffrery 1989
5) Basic concepts of analytical chemistry- S M Khopkar. 2008

Semester I
CH-303 Chemistry Practical

A) PHYSICAL CHEMISTRY EXPERIMENTS (Any Two)

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/ $BaCl_2$/ Urea) by using Landsberger apparatus.
3. Determination of standard electrode potential of Cu/Cu^{+2} or Ag/Ag^{+}, Zn/Zn^{+2} electrodes potentiometrically.

4. Conductometric titration of $Pb(NO_3)_2$Vs Na_2SO_4

B) VOLUMETRIC ANALYSIS (Any Five)

1. Estimation of acetic acid in commercial vinegar using NaOH.
2. Estimation of aspirin in drug sample.
3. Estimation of chloride by Mohr's method.
4. Estimation of Fe (II) by redox titration with $KMnO_4$.
5. Estimation of copper iodometrically.
6. Estimation of Mg^{+2} by complexometric titration with EDTA.
7. Determination of dissolved oxygen (DO) in water sample.

C) CHROATOGRAPHY (Any One)

1. Separation of mixture of o-nitro aniline and p-nitro aniline by Thin Layer Chromatography and to determine their Rf values.
2. Separation of mixture of any two amino acids by paper chromatography.

D) ORGANIC PREPARATIONS (Any Two)

1. Aniline to acetanilide by using Zn / Acetic acid.
2. Semicarbazone derivative of Aldehydes / Ketones.
3. Benzoyl derivative of – OH/ - NH_2.

Semester II
CH-403 Chemistry Practical

A) PHYSICAL CHEMISTRY EXPERIMENTS (Any Two)

1. Determination of critical solution temperature of phenol-water system
2. Determination of normality and strength of HCl titrating with standard NaOHPotentiometrically.
3. Construction of Daniel cell and determination of thermodynamic parameters. ΔG, ΔH, ΔS of the cell
4. Determination of molecular weight of liquid by steam distillation technique

B) ORGANIC QUALITATIVE ANALYSIS (Any five compounds)

Determination of a) Type b) Preliminary tests
c) Physical constant d) Elements (Sodium fusion test)
e) Functional groups f) Structure

C) GRAVIMETRIC ANALYSIS (Any Two)

1. Estimation of Ni as Ni-DMG (by Counterpoise method)
2. Estimation of Ba as $BaSO_4$ (by Ignition using filter paper)
3. Estimation of Pb as $PbCrO_4$ (by Gooch crucible / counterpoise method)

D)INORGANIC PREPARATIONS (Any One)

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

NOTE:
1) In all volumetric experiments it is expected from students to calculate quantity of primary standard substances and to prepare its solution. Then the other solution should be standardised.
2) Before starting the experiment, students must study Material safety data sheet (MSDS) of all chemicals used in experiments. Possibly the experiment should be declared one week earlier, so that it will be easy for students to do so.

Structure ofInternalPractical Examinations

Time:3Hours **Maximum Marks: 40**

1. Any one of the following experiments **30 Marks**

Physical chemistry experiment / Volumetric analysis / Chromatography / Organic Preparation

(For semester I)

Physical chemistry experiment / Gravimetric analysis / Organic qualitative analysis / inorganic Preparation**(For semester II)**

2. Oral **10 Marks**

Structure ofExternal PracticalExaminations

Time:3Hours **Maximum Marks: 60**

1. Any one of the following experiments 40 Marks

Physical chemistry experiment / Volumetric analysis / Chromatography / Organic Preparation**(For semester I)**

Physical chemistry experiment / Gravimetric analysis / Organic qualitative analysis / inorganic Preparation**(For semester II)**

2. Oral	**10 Marks**
3. Journal	**10 Marks**

Note: A student will not be permitted to appear at the practical examination unless he / she have performed the practicals and produced a certified journal.

EquivalencefortheS.Y.B.ScSyllabus

New Syllabus		Old Syllabus	
Course	**Semester-III**	**Course**	**Semester-III**
CH -301	**Physical And Inorganic Chemistry (Core Course)**	**CH -231**	**Physical And Inorganic Chemistry**
CH -302	**Organic and Inorganic Chemistry (Core Course)**	**CH -232**	**Organic and Analytical Chemistry**
CH -303	**Practical Chemistry**	**CH -233**	**Practical Chemistry**
CH- 304 (SEC-1)	**Basic Analytical Chemistry (Skill Enhancement Course)**		
	Semester- IV		**Semester- IV**
CH -401	**Physical And Inorganic Chemistry (Core Course)**	**CH -241**	**Physical And Inorganic Chemistry**
CH -402	**Organic and Inorganic Chemistry (Core Course)**	**CH -242**	**Organic and Analytical Chemistry**
CH -403	**Practical Chemistry**	**CH -243**	**Practical Chemistry**
CH -404 (SEC-1I)	**Advanced Analytical Chemistry (Skill Enhancement Course)**		